COMPARISON OF Y- MODIFICATION OF TRANSCONJUNCTIVAL APPROACH VERSUS SUBTARSAL – LATERAL EYEBROW APPROACH FOR ZYGOMATICOMAXILLARY COMPLEX FRACTURES - A PROSPECTIVE STUDY

A Dissertation submitted in
partial fulfillment of the requirements
for the degree of

MASTER OF DENTAL SURGERY

BRANCH – III
ORAL AND MAXILLOFACIAL SURGERY

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY
Chennai – 600 032

2012 – 2015

CERTIFICATE

This is to certify that **Dr. RAMYA DEVI.S**, Post Graduate student (2012–2015) in the Department of Oral and Maxillofacial surgery, Tamil Nadu Government Dental College and Hospital, Chennai – 600 003 has done this dissertation titled **"Comparison Of Y- Modification Of Transconjunctival Approach Versus Subtarsal – Lateral Eyebrow Approach For Zygomaticomaxillary Complex Fractures - A Prospective Study"** under our direct guidance and supervision in partial fulfillment of the regulations laid down by **The Tamil Nadu Dr. M.G.R. Medical University**, Chennai – 600 032 for **M.D.S.,** (Branch – III) **Oral And Maxillofacial Surgery** degree examination.

DR. D. DURAIRAJ, MDS.,
Professor and Guide

DR. B. SARAVANAN., MDS., PhD.,
Professor and Head Of the Department

Department of Oral and maxillofacial surgery
Tamil Nadu Government Dental College and Hospital
Chennai – 600 003

Prof. Dr. S. Premkumar., MDS.,
Principal Incharge
Tamil Nadu Government Dental College and Hospital
Chennai – 600 003.

DECLARATION

I, **DR. S. RAMYA DEVI,** do hereby declare that the dissertation titled "**COMPARISON OF Y- MODIFICATION OF TRANSCONJUNCTIVAL APPROACH VERSUS SUBTARSAL – LATERAL EYEBROW APPROACH FOR ZYGOMATICOMAXILLARY COMPLEX FRACTURES - A PROSPECTIVE STUDY"** was done in the Department of Oral and Maxillofacial Surgery, Tamil Nadu Government Dental College & Hospital, Chennai-600 003. I have utilized the facilities provided in the Government dental college for the study in partial fulfillment of the requirements for the degree of Master of Dental Surgery in the speciality of Oral and Maxillofacial Surgery (Branch III) during the course period 2012-2015 under the conceptualization and guidance of my dissertation guide, **Prof. Dr. D. DURAIRAJ**, **MDS**. I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Government Dental College & Hospital. I also declare that no part of this work will be published either in the print or electronic media except with those who have been actively involved in this dissertation work and I firmly affirm that the right to preserve or publish this work rests solely with the prior permission of the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, but with the vested right that I shall be cited as the author(s).

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Dr. D. Durairaj. MDS., aged 54 years working as **Professor** in Department of Oral And Maxillofacial Surgery at the college, having residence address at Sri Kumaran Illam, 3/19, first street, Ragava Nagar, Moovarasampet, Chennai. 600 091 (hereafter referred to as the 'Principal Investigator')

And

Dr. S. Ramya devi, aged 29 years currently studying as final year **Post Graduate student** in the Department of Oral And Maxillofacial Surgery, Tamil Nadu Government Dental College and Hospital, Chennai -3 residing at 21, V.H. Road, Pollachi. 642001. (hereafter referred to as the 'PG and co- investigator')

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Tamil Nadu Government Dental College and Hospital, Chennai - 3
Telephone No. 044 2534 0343
Fax 044 2530 0681

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Date: 29.04.2014

Title of the work: "Comparision of Y- Modification of Transconjunctival Approach Versus Subtarsal-Lateral Eyebrow approach for Zygomatico Maxillary Complex Fractures"

Principal investigator: **Dr.S.Ramya Devi,**
II Year MDS

Department : Oral & Maxillofacial Surgery
Tamil Nadu Government Dental College and Hospital, Chennai - 3

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ACKNOWLEDGEMENT

I express my gratitude to my Guide ***Prof. Dr. D. Durairaj M.D.S.,*** *Professor, Department of oral and maxillofacial surgery, Tamil Nadu Government Dental College and Hospital, for his guidance, support, and care during the course of my post graduate period.*

I am extremely grateful to ***Prof. Dr. B. Saravanan M.D.S., PhD.,*** *Professor & Head Of the Department, Department of oral and maxillofacial surgery, Tamil Nadu Government Dental College and Hospital, for his encouragement, valuable guidance, support and care during my course.*

My humble thanks to ***Prof. Dr.S.Premkumar, MDS.,*** *Principal Incharge, Tamil Nadu Government Dental College and Hospital, for his kind permission for the study.*

I express my special thanks to ***Prof. Dr. P. Srimathi MDS,*** *Professor, Department of oral and maxillofacial surgery, Tamil Nadu Government Dental College and Hospital, for her guidance throughout the PG period.*

I express my sincere thanks to ***Dr. J. Balaji MDS and Dr. Arunkumar MDS, Dr. G. Suresh kumar MDS,*** *Associate Professors, Department of oral and maxillofacial surgery, Tamil Nadu Government Dental College and Hospital, for their encouragement and support during my course of PG .*

I express my special thanks to ***Dr. S.B. Sethurajan MDS****, Senior Assistant Professor, my co-guide for helping me and providing me timely advice and help during my study period.*

My special thanks to ***Dr. D. Karthikeyan, MDS****,* ***Dr Davidson Rajiah, MDS****,* ***Dr. T. Rohini, MDS., Dr. K. Kamala kannan, MDS., Dr. M. Arulmozhi, MDS.,*** *Assistant professors, Department of oral and maxillofacial surgery, Tamil Nadu Government Dental College and Hospital, Chennai – 600 003 for their valuable suggestions, constant guidance and encouragement rendered throughout my study.*

My special thanks to ***Dr. Shalini****,* ***DMRD****, Department of Radiology, RGGGH, Chennai for helping in computed tomography images for the patients.*

A very special note of thanks to my mother ***Mrs. Jaya Samundeeswari****, my husband* ***Mr. Suresh Kumar B.Tech., MS****., brother Late* ***Mr. Ramesh Kumar****, my colleagues and friends for their prayers, guidance, patience and support throughout my life.*

I dedicate this work to my beloved father Late Mr. Sivaraju. BA.,BL., what I am now is because of him and nothing in my life would have been possible without him.

CONTENTS

LIST OF ABBREVIATIONS

FZS – FrontoZygomatic Suture

ZA - Zygomatic Arch

ZSS – ZygomaticoSphenoid Suture

RTA – Road Traffic Accident

M – Male

F – Female

CT – Computed Tomography

ORIF – Open reduction and Internal Fixation

3D – Three Dimensional

SD – Standard Deviation

LCT – Lateral Canthal Tendon

Introduction

INTRODUCTION

"Surgery needs exposure and exposure needs surgery"

Incision and exposure are the vital elements of surgery, and it is important that incisions should be carefully planned in the management of facial fractures due to its cosmetic influence on face. The facial fractures and the attempts to treat them record back to 25-30 centuries BC. The first documented treatment of zygomatic fractures were described in "The Smith Papyrus".[1]

The zygomaticomaxillary complex (ZMC) is an essential element in face configuration and due to its location and prominence it is the subject of greatest trauma incidence, with exception of the nasal bones.[2,3]

A variety of methods, ranging from conservative treatment to surgical treatment by closed reduction or open reduction and internal fixation (ORIF), can be successfully used to treat ZMC fractures. Surgical treatment is warranted in the presence of displacement, instability, or comminution of the bony fragments. Depending on the stability of the reduced zygoma, one, two or three point fixations have been applied.[4]

In cases of open reduction and fixation, multiple incisions have been described to access the lateral orbital wall and orbital floor which include lateral eyebrow, upper blepharoplasty, subciliary, subtarsal, infraorbital, transconjunctival and coronal. All these approaches have their advantages, disadvantages, and indications according to location of fracture, degree of displacement, and surgeon's experience with a specific technique.

Most tetrapod fractures require at least two point fixation for adequate stability. When two point fixation is desired in the frontozygomatic region and infraorbital rim, combination of incisions are used. For exposure of frontozygomatic area upper blepharoplasty or lateral eyebrow approach is used, of which lateral eyebrow incision is commonly used because it is very simple and rapid, no risk of injury to significant anatomic structures and the scar can often be concealed in the hairline of eyebrow.

For fixation of infraorbital area either a cutaneous or transconjunctival incision is used. Cutaneous incision includes subciliary, subtarsal or infraorbital incision. The subciliary approach has increased chance of ectropion and scleral show and the infraorbital approach is rarely used now a days due to its ugly scarring. The subtarsal (also known as mid-lid) approach was popularized by John Converse.[5] Although it is a transcutaneous approach which guarantees a skin incision, with the subtarsal position the scar can be predictably concealed. The subtarsal incision shares the advantage of inconspicuous scarring of subciliary approach and less complication rates of infraorbital approach. To decrease the complication rates of the cutaneous approach and to improve esthetics many surgeons have tried transconjunctival approach to access the orbital floor.

Bourquet first described the transconjunctival approach in literature in 1924.[6] In the early 1970s Tenzel and Miller described this approach for management of orbital floor fractures. When a conventional transconjunctival approach is used, a second incision at lateral eyebrow is required to fix frontozygomatic region, which increases the intraoperative time and provides less access and an unsightly scar. To overcome these difficulties, single transconjunctival incision with lateral canthotomy

incision was tried with success by many authors for two point fixation of ZMC fractures. Further improved access can be obtained by modifying the lateral canthotomy with a 'Y' shaped cutaneous incision in the lateral canthus area.[7] The anticipated advantages with this technique may be inconspicuous scarring, direct and full visualization of the lateral and inferior orbital wall through a single incision which may serve as guidance for an accurate reduction.

So, this study is to evaluate and compare the efficacy of the two approaches the transconjunctival approach with cutaneous 'Y' – modification and the combined subtarsal and lateral eyebrow approach for two point fixation of ZMC fractures.

Aim and Objectives

AIM

To evaluate and compare the efficacy of the Y-modification of transconjunctival approach with combined subtarsal – lateral eyebrow approach for two point fixation in management of ZMC fractures.

OBJECTIVES

To compare the following parameters with two different surgical approaches, the Y-modification of transconjunctival approach and combined subtarsal - lateral eyebrow approach in two point fixation for the management of ZMC fractures

1. Intraoperative time for both approaches.
2. Ease of surgical access and exposure.
3. Cosmetic outcome by scar assessment.
4. The parameters like fracture reduction and stability, resolution of infraorbital nerve paresthesia and achievement of adequate mouth opening post operatively were assessed.
5. To evaluate the post operative complications in both techniques.
6. To establish the merits and shortcomings of both approaches.

Review of Literature

REVIEW OF LITERATURE

The management of zygomaticomaxillary complex fractures has evolved through ages and has a long and interesting history. Early literature on these fractures described only the injury and in most cases, they were regarded as injuries with minimal displacement which required little or no treatment. As years passed by a variety of instruments and methods were devised and improved for surgical treatment with great success.

INCIDENCE

Covington et al in **1994** in a 10 year retrospective study of zygoma fractures and reported that of all facial fractures 18.6% patient had zygomatic fractures. Of the 259 patients with zygoma fractures they reported that ZMC fractures occurred in 78.8% of patients, isolated orbital rim fractures in 10.8% of patients, and isolated arch fractures in 10.4% of the patients. They also stated that 46.3% of zygoma fractures required open reduction and internal fixation .[8]

CLASSIFICATION

Knight and North Classification

Knight and North[9] in **1961** proposed the following system of classification

Group I : Undisplaced fractures.

Group II : Arch fractures.

Group III : Unrotated body fractures.

Group IV : Medially rotated body fractures.

Group V : Laterally rotated body fractures.

Group VI : Complex fractures

Larsen & Thomsen Classification

Larsen & Thomsen[10] in **1978** proposed the following system of classification

Group A : Stable fracture – Minimal or no displacement and requires no intervention.

Group B : Unstable fracture – Great displacement and disruption at the frontozygomatic suture and comminuted fracture. Needs reduction as well as fixation.

Group C : Stable fracture – The zygomatic fractures, which requires reduction, but no fixation.

Manson Classification

Manson[11] and colleagues proposed a more modern classification system with the use of CT scans.

Low-Energy Zygoma Fractures - Minimal or no displacement and their inherent stability usually obviates reduction.

Middle-Energy Zygoma Fractures - Fractures of all buttresses with mild-to-moderate displacement, and communition, adequate reduction and fixation required.

High-Energy Zygoma Fractures - frequently these type of fractures occur with Le Fort or panfacial fractures. A coronal exposure along with oral and eyelid incisions is usually necessary to properly reposition the malar eminence.

Rowe's & William's Classification[12]

1) Fractures stable after elevation

a. Arch only (medially displaced)

b. Rotation around the vertical axis. – Medially or Laterally

2) Fracture unstable after elevation .

a. Arch only (inferiorly displaced).

b. Rotation around the horizontal axis. Medially or Laterally

c. Dislocations enbloc Inferior, Medially or Posterolaterally.

d. Comminuted fracture.

Rowe & Killey Classification

In **1968** ***Rowe and Killey***[13] used the principle of vertical and horizontal axial rotations and en bloc displacement to classify zygomatic fractures.

Type I: No significant displacement

Type II: Fractures of the zygomatic arch.

Type III: Rotation around the vertical axis.

a. Inward displacement of orbital rim.

b. Outward displacement of orbital rim.

Type IV: Rotation around the longitudinal axis.

a. Medial displacement of the frontal process.

b. Lateral displacement of frontal process.

Type V: Displacement of the complex enbloc

a. Medial

b. Inferior

c.Lateral

Type VI: Displacement of the orbitoantral partition

a. Inferiorly

b. Superiorly

Type VII: Displacement of orbital rim segments.

Type VIII: Complex comminuted fractures.

Zingg Classification

Zingg et al in **1992** classified zygomaticomaxillary complex fractures into three types A, B, and C. [14]

Type A- injuries are isolated to one component of the tetrapod structure,

Type A1 - zygomatic arch

Type A2 - the lateral orbital wall

Type A3 - the inferior orbital rim.

Type B - fractures involve all 4 buttresses (i.e., classic tetrapod fracture).

Type C - injuries are complex fractures with comminution of the zygomatic bone itself.

MUSCLE FORCES ON ZYGOMA FRACTURES

Rinehart et al in **1995** reported that the instabilities of ZMC fractures are directly due to the masseter muscles action, and indirectly attributed to the medial pterygoid and temporal muscles besides fiber association of the facial expression muscles, although there was no rotation of the zygomatic bone noted when simulating action of masseter muscle forces in ZMC fractures fixed in two points: the frontozygomatic suture and infraorbital ridge. [15]

Ellis & Kittidumkerng in **1996** evaluated clinically and radiographically 22 patients after 6 months of ZMC fractures surgeries and showed that the existence of illpositioned zygomatic bone, probably demonstrate only that these ZMC fractures were not adequately reduced. So, they believe that post surgery illposition of the zygomatic bone which was frequently related to masseter muscle action, can now be related to an inadequate reduction. [16]

OPTHALMIC INJURIES ASSOCIATED WITH ZYGOMA FRACTURES

Basem et al in **2009** did a retrospective, descriptive case study to assess the spectrum and incidence of ophthalmic involvement in patients with ZMC fractures. They concluded that comminuted ZMC fractures was reported to be associated with a significantly higher incidence of visual sequelae than the other forms of midfacial injury. Also 10% incidence of major or blinding injuries and 6% incidence of traumatic optic neuropathy are significant, and these warrants a prompt ophthalmologic examination preoperatively of all patients with ZMC fractures as early as possible, requiring surgical repair. [17]

INVESTIGATIONS

Ogunmuyiwa et al in **2012** discussed that Computed tomography (CT), both coronal and axial planes, is often required in complex cases to assess blow-out fractures and disruption of the orbital walls because CT is considered to be the gold standard for radiologic diagnosis of ZMC fractures. [18]

MANAGEMENT

Du Verney in **1751** first described the anatomy, pattern of fractures, and approach to reduction of zygoma in two cases. [19]

In **1847**, ***Dupuytren*** detailed an intraoral and an external technique to reduce a medial displaced zygomatic arch. He also described an approach to the zygomatic arch by way of a plane between the temporalis muscle and deep temporalis fascia. [20]

In **1906**, ***Lothrop*** first described an antrostomy through Highmore antrum to reach the fractured zygoma, now popularly known as Caldwell-Luc approach. [21]

Keen in **1909** categorized zygomatic fractures as that of the arch, the body, or the sutural disjunction. It was Keen who first described an intraoral approach for management of fractured zygoma via a gingivobuccal sulcus incision. [22]

In **1927**, ***Gillies*** and ***Kilner*** described an incision to be made behind the hairline to reach the malar bone. Even today Gillies method is the method of choice to elevate zygomatic arch fractures. [23]

In **1927**, ***Kazanjian*** placed a screw into the malar bone in place, and attached the screw to a transcutaneous wire for headcap traction.[24]

Adams et al in **1942** recognized the need for greater stabilization in the treatment of more comminuted fractures and he was the one who first wrote about internal wire fixation. This technique, which was described by Adams, remained the main stay treatment earlier in many institutions before the advent of miniplates. [25]

Fryer in **1950** stabilized of zygomatic fractures with the help of transcutaneous Kirschner wires.[26]

Dingman and Natvig in **1964** performed a study which demonstrated that many zygoma fractures which treated by a closed reduction technique and when later re-examined were more severe than they appeared clinically or by roentgenographic evaluation. Although It appeared that the fracture was reduced at one point, the bone again became displaced due to extrinsic forces. So , they concluded that most appropriate treatment for displaced fractures of the zygoma was open reduction and direct wire fixation. [27]

Brown, Fryer, and McDowell in their publication in **1951**, advocated the use of internal wire-pin fixation. They used Kirschner wires, either alone or in combination with direct wiring, to stabilize the middle-third facial fractures. [28]

Boudreaux in **1957**, used a new instrument, a modified urethral sound with a elliptical shaped handgrip for the elevation of ZMC fractures. [29]

Samuels and Oatis in **1970** reported the use of Kirschner wires in management of zygoma fractures after elevation with percutaneous hook. In this study, they passed the Kirschner wire from the stable uninjured zygoma to the stabilized zygoma on injured side through the nose and antrum. This technique avoids open reduction, and also provided immediate rigid fixation and shortened the hospitalization. [30]

Podoshin and Fradis in **1974** suggested a method for the reduction of zygomatic arch fractures by the use of Foley catheter. In this technique the balloon in the catheter is filled with contrast medium, which aided in the better placement and position of the fractures parts. They concluded that this method is simple, without complications and superior to the methods used so far. [31]

David poswillo in **1976**, suggested a technique of fracture reduction of malar complex by direct extraoral application of a specially designed traction hook. [32]

Osteosynthesis for treatment of facial fractures became a reality in 1970s. The Swiss AO group and Association for the Study of Internal Fixation developed miniplate fixation.

Michelet et al in **1973** published the first report of rigid fixation for the treatment of fractures of the midface. They developed techniques for reduction and fixation of facial fractures using miniplate. [33]

INTEROSSEOUS WIRING VS MINIPLATE FIXATION

Several treatment methods for ZMC fractures are reported, all of them with the same aim: bone repositioning, and functioning of the patient and to restore the esthetics.[34]

Manson et al in **1980** reported that midface retrusion, shortening as well as maxillary rotation have been reported as complications of suspension wiring which resulted in malocclusion in as much as 19.6% of cases.[35]

Manson et al in **1985** described open exposure of the zygoma and maxilla with 4-point wire fixation and use of bone grafting. Acceptable alignment of the zygoma was achieved and there was minimal bone graft resorption.[36]

Klotch and Gilliland in **1987** reported that interosseous wire fixation of ZMC fractures with limited exposure had a prolonged recovery period and significant surgical morbidity. Because of the limited stability of wiring technique, IMF was prolonged, making nutritional optimization difficult. Also they reported ankylosis at the temporomandibular joint after prolonged immobilization which required protracted rehabilitation, contributing to the functional impairment of the injury. Closed reduction and wire suspension of the lower midface did not allow for stable buttress reconstruction, and it required more bone grafts to maintain projection and height of the midface, also resulted in significant loss of bone graft volume. [37]

Rohrich and Watumull in **1995** did a direct comparison to interosseous wiring of zygoma fractures with the benefits of miniplate fixation with regard to malar projection, cheek sensation and globe position and compared with the contralateral side. Rigid plate fixation demonstrated significance than wire fixation in terms of malar symmetry, and approached significance in improvement of globe position. No differences were found in cheek sensibility. [38]

Rinehart et al in **1989** reported that the rigid miniplate fixation provides consistently better zygomatic and symmetry of globe than interosseous wires, and deforming forces of this magnitude required at least 2 miniplates. [15]

Zachariades et al in **1998** mentioned that fixation of fractures with mini or micro plates provides better rigidity and stability than wiring of fragments. [2]

Tadt et al in **2003** reported that both closed and open reductions are good treatment modalities and were used in near equal numbers of patients. There is a higher incidence of postoperative facial deformity with regard to closed reduction group, but more complications related to the incisions in the open reduction group. Open reduction and internal fixation can be advocated for unstable, markedly displaced or comminuted fractures. Silastic sheeting is a favoured graft material for repair of the associated orbital floor defects and is reported to be associated with few complications. [39]

Mofid MM and Thompson in **1997** reported that vitallium (cobalt-chromium-molybdenum) and titanium, produces a substantially less aggressive foreign body reaction. Titanium is favored over Vitallium because of its lack of significant artifact on postoperative computed tomography and magnetic resonance imaging scans. [40]

Orringer et al in **1998** reported that potential complications of internal rigid fixation systems include infection, palpable or painful hardware, nonunion, and the often under recognized issue of misalignment of the fracture fragments during reduction. This latter phenomenon has been termed OIF, or ‘‘open internal fixation’’ without reduction. Review of indications for hardware removal cited plate palpability as the most common reason, followed by pain, loosening of hardware, and exposure of plates. [41]

AMOUNT OF FIXATION

The literature on ZMC fracture treatments is conflicting regarding the need of for fixation and amount of fracture fixation after their surgical reduction.

Fain et al in ***1981*** obtained success by fixation in only one point of the frontozygomatic suture, because this is the area where the tension forces act directly.[42]

Manson et al in **1987** reported that fixation is essential to prevent the rotation of the zygomatic bone, and stability can be achieved both with plates and screws, in one or two points, with no need for fixation it in three or four points, other than cases of comminuted fractures. [43]

Zingg et al in **1992** report that a fixation in two points is enough for stabilizing ZMC fractures. They also reported that the determinant factor to define the best treatment will be trans-surgical, where it is possible to verify the degree of instability of the fracture. [14]

Seon Tae Ki et al in **2011** reported that open reduction and internal fixation has been used as the standard method for treating zygomaticomaxillary complex

fractures. Depending on the stability of reduced zygoma, 1-, 2-, or 3-point fixations have been applied. [4]

Bacelli et al in **2002** reviewed the literature and concluded that many authors inform that safe stability in ZMC fractures is reached through a three-point fracture fixation, to counteract the muscle action in these fractures. [44]

Bassi et al in **2014** reported that based on the radiographic and clinical findings the surgical reduction and the stable internal fixation in two points were found to be the adequate treatment for the cases of non-comminuted fractures of the ZMC. [45]

Manson in **1996** did an analysis on isolated ZMC fractures and concluded that the zygomaticomaxillary buttress is a good place for zygoma alignment and that the frontozygomatic suture is the best bone for fixation but the worst single-alignment guide. [46]

Seon Tae Kim et al in **2011** did a study on 1 point vs. 2 point fixation in ZMC fractures and summarized that one-point fixation in the ZM area in zygomatic tripod fractures can avoid unsightly scars and give high satisfaction with surgical outcomes in selected patients with tripod fractures. [4]

Hammer & Prein in **1995** concluded that an incorrect primary reconstruction is the basic etiology of posttraumatic deformities, such as telecanthus, enophthalmos, and loss of zygomatic prominence. [47]

Perino et al in **1984** reported that according to literature, reports suggest that the facial asymmetry may occur in 20 to 40% of the cases of ZMC fractures in rigid

internal fixations. Usually it is related to the time taken to conduct the surgical reduction, and also to the failure in obtaining a proper surgical access for an adequate exploration of the fracture sites. [48]

VARIOUS INCISIONS USED IN THE MANAGEMENT OF ZMC FRACTURES

Supratarsal Incision

Chuong and Kaban in **1986** was the first to describe the supratarsal fold approach for a zygomaticomaxillary fracture. [49]

Fonseca described the supratarsal fold approach as an aesthetically viable alternative for the exposure of the zygomaticofrontal suture. [1]

Kung and Kaban in **1996** described supratarsal incision as having exceptional aesthetic results in management of ZMC fractures that create an inconspicuous scar. [50]

Bruno et al in **2008** reported that complications of the supratarsal fold may include exposure of orbital fat and lacrimal glands caused by dissection of the orbital septum and this can be avoided by careful dissection in the subperiosteal plane. [51]

Subtarsal Incision

John Converse in **1944** popularised the subtarsal (also known as mid-lid) approach. This incision is made 5 to 7 mm inferior to the lower lid margin, in one of the subtarsal creases, and it extends laterally into or parallel to one of the resting skin tension lines and located along the lateral aspect of the orbit. [5]

Evan et al in **2011** indicated that the optimal placement of the subtarsal incision is as close as possible to the inferior border of the tarsal plate. The subtarsal incision should be placed within an existing skin crease, if possible, and it should be

made with the knowledge that the more inferior the incision is placed, the greater the visualization of the fracture, and also more visible the scar [52]

Zaid et al in **2008**, in a long term follow up of 12 cases concluded that the subtarsal approach is a safe and simple to perform procedure for treatment of orbital floor fractures. It also results in good surgical outcome functionally and esthetically.[53]

Transconjunctival Incision

Bourquet in **1924** in French literature reported the use of the transconjunctival approach for the removal of the orbital herniated fat. [6]

Tenzel and Miller in **1971** used the transconjunctival approach for the surgical management of small blowout fractures. Also, they developed the transconjunctival retroseptal approach. [54]

In **1973**, ***Tessier*** popularised the transconjunctival approach for exploration of orbital floor in the cases of congenital deformities, trauma and described the transconjunctival preseptal approach. [55]

Converse et al in **1973** popularized the transconjunctival technique for the management of orbital fractures.[56]

McCord and Moses in **1969** described the addition of the lateral canthotomy incision to gain access to the lateral orbital wall and inferior orbital rim. [57]

Nunery in **1985** reported an lateral superior cantholysis for the repair of trimalar fractures. [58]

Mullins et al in **1997** did a retrospective study in 400 cases of transconjunctival approach to review the intraoperative and post operative complications and stated that the potential complications associated with this approach are conjunctival granuloma, entropion, hematoma, ectropion, prolonged chemosis, conjunctival inclusion cyst, lower eyelid laceration, and lacrimal system injury. He concluded that the complications associated with transconjunctival approach are uncommon. Also, when they occur proper management results in a successful outcome. [59]

Ho and Rowland in **2004** evaluated early postoperative results and complications in patients with isolated orbital floor fractures through a transconjunctival and sutureless incision. No complications occurred other than 1 patient (3.8%) who had early migration of the orbital implant that did not require further intervention. They concluded that sutureless transconjunctival approach provides an excellent functional and cosmetic result. [60]

Eli et al in **2005** conducted a retrospective study on twenty patients with zygomatic fractures by using a simplified technique of using a T-bar screw for reduction through a transconjunctival approach. They results showed that all patients underwent successful reduction with this simplified technique. No complications occurred. They concluded that the use of the T-bar through a transconjunctival approach is a simplified and effective technique for zygomatic fracture repair. [61]

Santosh et al in **2011** did a study on 15 cases to evaluate the transconjunctival preseptal approach and conclude that the transconjunctival preseptal approach is the most effective approach for surgical access to infraorbital rim and orbital floor and

even to medial orbital wall. The transconjunctival approach is surgically similar in providing exposure and access, but aesthetically is superior to other approaches and has minimal complications. There are no disadvantages in transconjunctival preseptal approach, if performed meticulously with sound knowledge of anatomy of periorbital tissues. [62]

Kim et al in **2009** reported that the extended transconjunctival approach provided sufficient surgical exposures for fracture reduction and fixation in all cases. None of the complication reported in the follow up period. The cutaneous scars were almost invisible in most cases. They concluded that the extensiveness of this approach makes continuous exposure of frontozygomatic suture laterally to the frontonasal suture medially, while minimizing scar and eyelid complications. [63]

Lee et al in **2006**, conducted a study in 53 patients of ZMC fractures with a single transconjunctival incision and two-point (inferior orbital rim and frontozygomatic suture) fixation. They encountered 3 minor complications, and the overall esthetics and functional results were satisfactory with a long term follow-up. They reported that this technique leaves a inconspicuous lateral canthal scar and also provides excellent simultaneous visualization of the frontozygomatic suture area and inferior orbital rim. They concluded that two-point fixation through a single incision, can be performed with a satisfactory stability. [64]

Novelli et al in **2011** conducted a transconjunctival approach on orbital trauma patients and evaluated the incidence of intra or postoperative complications. They encountered four temporary postoperative complications and no long-term complications and concluded all complications, as described in the literature, were transitory

and they did not require corrective surgery. This approach is simple to perform and gives good functional and aesthetic results. [65]

Waite and Carr in **1991** made a prospective study in twelve patients with maxillofacial injuries and they treated them with a single transconjunctival incision and lateral canthotomy for orbital floor, and inferior and lateral rim reconstruction. The follow-up was 12 months, during which time there was no immediate or delayed complications. They concluded that the exposure and access was satisfactory in all the cases for reduction and rigid fixation of both lateral and inferior rim through a single incision. [66]

In **1994**, ***Shaw*** and ***Khan*** conducted a study in patients with complex trimalar fractures. All patients were treated by a transconjunctival approach with lateral canthotomy. There reported seven minor complications. They concluded that ninety-three percent of patients were either very satisfied or satisfied with their functional and cosmetic results with this single incision approach. [67]

Manson et al in **1987** made on study with a single lower eyelid incision either transconjunctival or subciliary with mobilization of the lateral canthus for exposure of zygoma, zygomaticofrontal suture, lower and lateral orbit. They concluded that these approaches reduce cutaneous scarring and also provide adequate exposure of the lower and lateral orbit. Predictable and improved aesthetic results are routinely achieved. [43]

Manganello-Souza et al in **1997** presented their experience with transconjunctival approach to access the orbital floor, zygomatic-frontal, infraorbital rim and zygomatic temporal sutures in patients with ZMC fractures. Though they

reported a complication rate of 12.5%, they concluded that the esthetic results and simultaneous visualization of the infraorbital rim and lateral orbital rim supports the use of the transconjunctival approach. [68]

Uemura et al in **2001** designed a new approach using a C-shape extended transconjunctival approach to have one field of vision to osteotomize the frontozygomatic suture, the lateral orbital wall, inferior orbital rim, lateral maxillary buttress, and zygomatic arch. They concluded that it takes less operating time and the post-surgical scars are shorter than the bicoronal approach. [69]

Patel et al in **1998**, conducted a retrospective study to compare the exposure provided and the rate of complications between transconjunctival and subciliary incisions for orbital rim and floor fractures. A total of 30 transconjunctival and 30 subciliary incisions had been performed, and the adequacy of exposure, intraoperative and postoperative complication rates were compared. They found a higher rate of complications with the subciliary approach and, therefore, they advocate the use of a transconjunctival incision for the management of orbital fractures.[70]

Lateral Eyebrow Incision

Seon Tae Kim in **2011** did a study on 1 point Vs 2 point fixation in ZMC fractures and stated that maxillofacial fractures frequently occur in young persons, and lateral eyebrow incision is a burden to the surgeons and patients because of unsightly postoperative scars. Also, metal plates and screws used for fixation sometimes require operations for plate removal and repeated incisions may leave further unsightly scars. The complications of lateral eyebrow incision are unsightly scars, palpability of plate, and risk of penetration into the anterior cranial fossa.[4]

COMPARISON OF ORBITAL INCISIONS

Wray et al in **1977**, did a study comparing subciliary skin--muscle flap incisions to retroseptal transconjunctival incisions for orbital fracture repair. Four of the 45 eyelids treated by the subciliary approach had ectropion which was managed by subsequent surgery. Also they reported one case of ectropion and one lid laceration by traction in the transconjunctival group. The laceration due to traction prompted the authors to perform a lateral canthotomy in 25 of the 45 transconjunctival approaches to improve the access.[71]

Appling et al in **1993** did a retrospective study comparing subciliary skin--muscle and preseptal transconjunctival approaches in patients with orbital fracture repair and found a 12% rate of transient ectropion and 28% rate of permanent scleral show with the subciliary skin-muscle flap compared with no transient ectropion and 3% rate of permanent sclera show, 9% canthal malposition, and all patients experienced several weeks of chemosis with the transconjunctival approach.[72]

Patel et al in **1998** retrospectively evaluated transconjunctival approaches for management of orbital fracture and reported that in transconjunctival groups postoperative complications were increased scleral-show, granuloma, and lower lid laceration. He also performed lateral canthotomies to obtain adequate exposure to the fracture site. [70]

Arnulf Baumannn and Rolf Ewers conducted a study in **2001**, on patients undergoing orbital reconstruction surgery and reported no complications in patients with preseptal transconjunctival approach. But patients with subciliary incision had

complications like laceration of tarsal plate and temporary entropion. The overall complication rate was reported to be 2%.[73]

Holtmann et al in **1981**, conducted a randomized prospective study by comparing four incisions for access to the orbital floor fractures. He stated that "fracture exposure was adequate with all but transconjunctival incisions. So, lateral canthotomy was added in 56% of cases to improve exposure. The transconjunctival approach took almost 3 times longer to perform than the transcutaneous approaches. They concluded that the lower eyelid incision provided a more rapid, direct approach to orbital floor and infraorbital rim fractures with minimal morbidity. The scars were acceptable in subciliary approach to the combined transconjunctival lateral canthotomy scars, they recommend the use of the subtarsal (mid-lid) approach.[74]

Netscher et al in **1995** performed a prospective study comparing transcutaneous versus transconjunctival approach for lower lid blepharoplasties. They performed nonstepped, skin-muscle subciliary approach on the left and transconjunctival approach on the right side. There was no significant difference in the amount of scleral show between the two incisions, nor there was any difference in fornix depth. They also concluded that there was no perceptible scar difference from one side to the other. [75]

Bahr et al in **1992** did a study in one hundred and five patients of orbital trauma through subciliary, mid-lower eyelid, or infraorbital incisions. The results showed that impairments persisting up to six months postoperatively have virtually not receded even after six years. The infraorbital incision showed the highest frequency of impairments, followed by the subciliary incision. The mid-lower eyelid

incision or the subtarsal incision showed the best results, with an impairment frequency well below those of the other two approaches. Subtarsal approach seems to combine the advantages of the infraorbital incision with the unnoticeable scar formation associated with the subciliary incision. [76]

COMPLICATIONS OF ZMC FRACTURES

Some of the consequences of the Zygomaticomaxillary complex fractures are severe morbidity, visual disturbances, disfigurement, and function loss. The sequelae of not properly treating ZMC fractures are facial deformity, sensory deficits involving the infraorbital nerve, enophthalmos, orbital dystopia, diplopia. Failure to perform appropriate and correct reduction of zygomatic fractures can cause late complications. The primary cause of post reduction displacement of ZMC fracture is often attributed to masseter muscle. [77]

The infraorbital nerve paresthesia after ZMC fractures reports to be approximately 18 to 83%. Ophthalmic complications following ZMC fractures are enophthalmos, traumatic optic neuropathy diplopia, traumatic hyphema, retrobulbar hemorrhage and superior orbital fissure syndrome. Trismus after ZMC fracture is mainly attributed to compression of the coronoid process of the mandible, injury of the adjacent masticatory muscles and fibrous or bony adhesion between the zygomatic arch and the coronoid process. The cause of trismus may be due to direct tearing or impinging on the masseter and temporalis fascia or indirectly from muscle spasms subsequent to fracture and hematoma formation. Failure to treat such patients may lead to fibrous adhesion between the zygomatic arch and the coronoid process, in a condition known as extracapsular pseudoankylosis. [78]

John et al in **2003** reported the following complications after treatment of zygomatic fractures with rigid fixation like cosmetic deformities, residual telecanthus, nerve paresthesia, ocular injury, diplopia, enophthalmos and other problems with rigid fixation. Globe injuries may include globe rupture, corneal abrasion, or retinal detachment. [79]

Manson et al in **1986** reported that small volumetric changes within the orbit may result in enophthalmos. He concluded that changes as small as 5% in orbital volume may result in significant changes in position of the globe. [80]

Robideaux in **1978** reported on the oculo-cardiac reflex that occurred during midface disimpaction. [81]

Schuknecht et al in **1996** evaluated patients with persistent enophthalmos after zygomatic fracture with CT imaging. They reported clinical enophthalmos of 2.5 to 3 mm, with a mean increase in orbital volume of 3.4 ml on CT imaging and 3.5 to 5 mm of enophthalmos, with an increase in orbital volume of 7.1 mL.[82]

Fells in **1982** reported that 3 mm or more of enophthalmos compared to the contralateral side is cosmetically unacceptable to patients.[83]

Barclay in **1958** concluded that approximately 10% of patients suffer from initial diplopia, and 5% have permanent diplopia after fractures involving the zygomatic bone.[84]

Zingg et al in **1992** in a study conducted on 1025 patients of ZMC fractures showed an incidence of 23.9% of diplopia in his series. In his series Zingg also reported an incidence of maxillary sinusitis of in zygomatic fractures.[14]

Surgical Anatomy

SURGICAL ANATOMY

ZYGOMA

Zygoma is a paired bone which is roughly quadrilateral in shape and has an outer convex (cheek) surface and an inner concave (temporal) surface. The ZMC occupies a key position in the anterolateral aspect of the face, contributing to set the midface width, and to define the shape and contour of the inferior and lateral orbital borders as well as the cheek prominence. It is a tetrapod structure (fig. 1) relating to

1. Maxilla at the zygomaticomaxillary buttress (ZMB) and at the inferior orbital rim (IOR)
2. Frontal bone at the frontozygomatic suture(FZS)
3. Temporal bone forming the zygomatic arch (ZA)
4. Sphenoid bone at the zygomaticosphenoid suture (ZSS).

This tetrapod configuration itself leads to complex injuries, as fractures here rarely occur in isolation.[85] The frontal process is thick, triangular in cross-section, due to its greater thickness, it is a frequent site for wire or bone plate fixation following fracture. The temporal process is flat and articulates posteriorly with the zygomatic process of the temporal bone. The combination of these two bones makes up the zygomatic arch. The zygomatico-temporal articulation is very delicate and thin which fractures frequently and with minimum force. The infraorbital rim and lateral orbital rim are strong which provides protection to the orbital contents.

ATTACHMENTS

The zygoma serves as the attachment point for muscles of both mastication and facial animation, but among these, it is the masseter that provides the most significant intrinsic deforming force on the zygomatic body and arch. Also, the temporal fascia attaches along the zygomatic arch and posterolateral edge of the

temporal process. The temporal fascia produces resistance to inferior displacement of a fractured fragment by the downward pull of the masseter muscle. The zygoma also gives attachment for temporal and zygomatic muscles.

NERVE SUPPLY

The sensory nerve associated with the zygoma is the maxillary division of the trigeminal nerve. The facial, zygomatic and temporal branches exit the foramina in the body of the zygoma and supply sensation to the cheek and anterior temporal region. The infraorbital nerve exits at the infraorbital foramen and provides sensation to the anterior cheek, lateral nose, upper lip, and maxillary anterior teeth.

ORBIT

The zygoma plays an integral role with the orbit, as it buttresses the orbit and forms the majority of the lateral orbital wall and floor. In fact, the term orbitozygomatic fracture is perhaps more accurate, as isolated fractures of the zygoma without orbital involvement present rarely.[86] So, any discussion about zygomaticomaxillary complex fractures is not complete without the discussion on orbit, as most of the fractures involves the orbital floor and the lateral wall of orbit. The floor is composed of the orbital plate of the maxilla, the orbital surface of the zygomatic bone, and the orbital process of the palatine bone. The orbital floor is thin and is frequent site for fracture. The lateral orbital wall is the thickest and is formed by the greater wing of the sphenoid and the zygoma.

The position of the globe in the horizontal axis is maintained by Lockwood's suspensory ligament. The canthal tendons maintains the shape and location of the medial and lateral canthi of the eyelid. The lateral canthal tendon is attached to Whitnall's tubercle. The medial canthal tendon is attached to the anterior and

posterior lacrimal crests. Zygomatic complex fractures are sometimes accompanied by an antimongoloid (downward) cant of the lateral canthal region caused by displacement of the zygoma when fracture occurs above the whitnall's tubercle.

As this study involves the subtarsal and the transconjunctival approach along the lower eyelid, the layers of the lower eyelid are discussed.

LOWER EYELID :

The lower eyelid consists of at least five distinct layers in the sagittal section[87] as shown in fig. 2.

- Skin
- subcutaneous tissue
- Orbicularis oculi muscle
- Tarsus (upper 4 to 5 mm) or orbital septum
- Conjunctiva

Skin *is* the outermost layer and has many elastic fibers which allows it to be stretched during dissection and retraction. The skin derives its blood supply from the underlying perforating muscle vessel. The subcutaneous tissue consists of loose connective tissue.

The orbicularis oculi muscle lies subjacent and adherent to the skin which forms the sphincter of the eyelids. It is divided into orbital and palpebral portions . The palpebral portion can be further subdivided into two parts : pretarsal portion and the preseptal portion. The upper and lower pretarsal muscles contribute to a common lateral canthal tendon about 7 mm from the lateral orbital tubercle, where it inserts. The orbicularis oculi muscle receives innervation from branches of the facial nerve

that enter the muscle on its deep surface. The blood supply to the orbicularis oculi muscle is from the external facial artery tributaries that come from deep branches of the ophthalmic artery.

The orbital septum forms a diaphragm between the contents of the orbit and the superficial face. It is a fascial extension of the periosteum of the bones of the face and orbit. Laterally and inferolaterally it arises from the periosteum 1 to 2 mm beyond the rim of the orbit. Thus, it is necessary to dissect a few mm lateral and/or inferior to the orbital rim before incising the periosteum to prevent incising through the orbital septum. If orbital septum is incised, the orbital fat is exposed which interferes with surgery. The orbital septum in the lower eyelid inserts onto the inferior margin of the lower tarsus. The tarsal plate of the lower eyelid is somewhat thin, pliable fibrocartilaginous structure that gives form and support to the lower eyelid . Laterally, the tarsal plate becomes a fibrous band that adjoins the structural counterpart from the upper lid, forming the lateral canthal tendon. Medially, the tarsal plate also becomes fibrous and shelters the inferior lacrimal canaliculus behind as it becomes the medial canthal tendon. The incision is placed in the conjunctiva just below the tarsal plate.

A grayish line or a slight groove sometimes visible between the lashes and the openings of the tarsal glands represents the junction of the two fundamental portions of the eyelid, the skin and muscle on one hand and the tarsus and conjunctiva on the other. This indicates a plane along which the lid may be split into anterior and posterior portion with minimal scarring.

Palpebral Conjunctiva lines the inner surface of the eyelids. It adheres firmly to the tarsal plate, and as it extends inferiorly toward the inferior conjunctival fornix,

it becomes more loosely bound. At the inferior conjunctival fornix, the conjunctiva sweeps onto the ocular globe to become the bulbar conjunctiva.

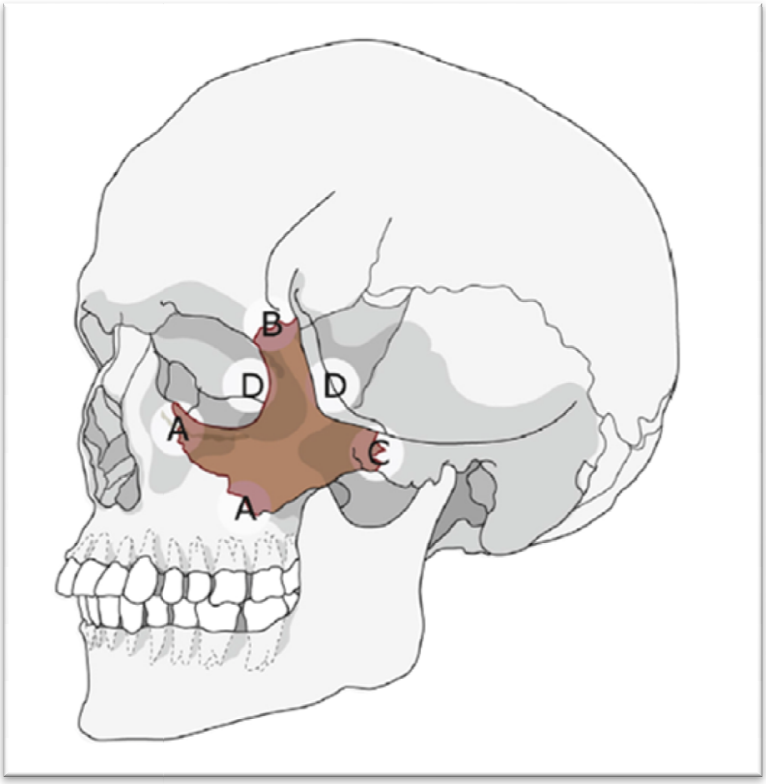
LATERAL CANTHAL TENDON (LCT)

The lateral canthal tendon, ligament, or raphe is a fibrous extension of the tarsal plates laterally toward the orbital rim. The lateral canthal tendon has a superficial and deep component. The base of the ligamentous complex is shaped like a Y and is attached to the external angle of the two tarsi. The thicker, stronger deep component of the lateral canthal tendon courses posterolaterally, inserting into the periosteum of the orbital tubercle of the zygoma, approximately 2 to 3 mm posterior to the orbital rim. The superficial bundle runs under the orbicularis muscle and continues over the frontal process, and it attaches to its periosteum and to the temporal aponeurosis.[7]

A popular incision used to gain access to the superolateral orbital rim is the eyebrow incision. No important neurovascular structures are involved in this approach, so it gives simple and rapid access to the frontozygomatic area. If the incision is made entirely within the confines of the eyebrow, the scar is usually imperceptible. However, occasionally some hair loss may occur, making the scar perceptible. In individual who has no eyebrows extending laterally and inferiorly along the orbital margin, this approach is undesirable.

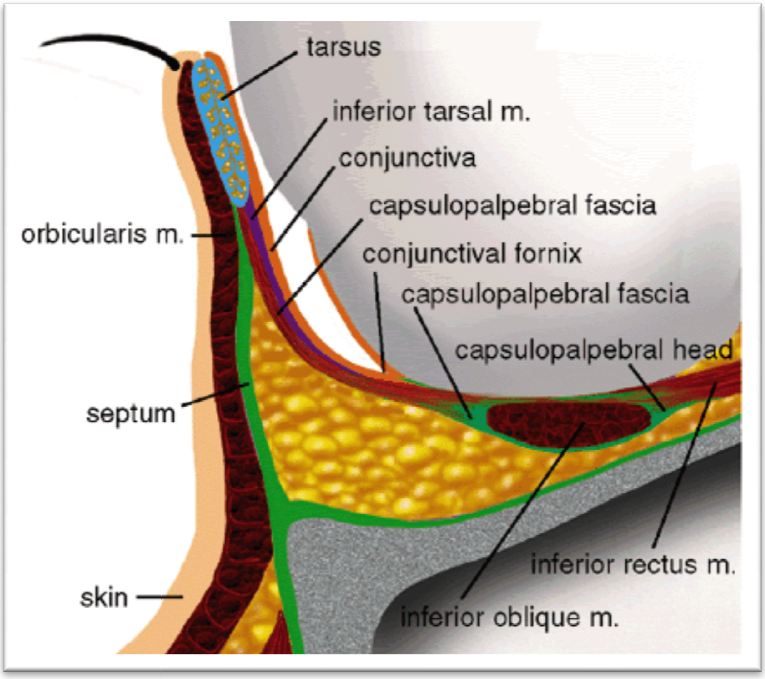
FIG. 1 ZYGOMATIC BONE ARTICULATIONS

A - Maxilla; B- Frontal bone; C - Temporal bone; D- Sphenoid bone.



Courtesy : Rodrigo Otavio Moreira Marinho, Belini Freire-Maia, Management of Fractures of the Zygomaticomaxillary Complex. Clinics of North America 2013; 25(4) : 617-636.

FIG.2 LAYERS OF LOWER EYELID – SAGITTAL SECTION



Courtersy : AO surgery reference , web source

Materials and Methods

MATERIALS AND METHODS

The patients who reported to the Department of Oral and Maxillofacial Surgery, Tamil Nadu Government Dental College and Hospital, Chennai with Zygomaticomaxillary complex fractures were included in the study. The patients in whom the fractures required ORIF was considered in the study with the following criteria :

INCLUSION CRITERIA

1. Unilateral ZMC fractures.
2. All healthy Individuals between 15- 55 yrs of age, of both sexes will be included
3. Patients without ophthalmic and neurologic injury.
4. Patient willing for follow up of at least 3 months.

EXCLUSION CRITERIA

1. Medically compromised patients.
2. Patients with preoperative reduced vision, or dry eyes, or epiphora;
3. Patient with dacrocystitis, conjunctivitis, or conditions of the margin of the lid such as stye or blepharitis;
4. Patients with any deformity of the eye;
5. If the conjunctiva, globe, or were affected by trauma ; or if it is the only serving eye.

STUDY DESIGN : Prospective Study

SAMPLE SIZE : 10 patients, 5 in each group

This is a prospective study conducted on 10 patients of which 8 patients were male and 2 patients were female. The age at the time of surgery ranged from 18 to 39 years, average age was 29.1 years. All the patients had unilateral fractures of which 9 patients had fracture on left side and in only one patient the fracture was on right side. In 8 patients trauma was due to RTA, in one patient is was due to sports injury and in one patient assault was the cause of trauma. The average follow up was 3 months.

After eliciting a detailed history, a complete clinical examination was carried out. Radiographic evaluation included PNS (ParaNasal Sinus) view, Submentovertex view and CT scans taken in axial, coronal and sagittal sections and then the treatment plan was formulated. In this study pre operative ophthalmic examination was done for all patients by ophthalmologist and the patient was included in the study after ruling out the possible ocular injury. Ethical approval was obtained from the institutional ethical committee to proceed with the study and an informed consent was taken from the patient explaining the true nature of the surgical procedure and the study in both English and in regional language (Tamil).

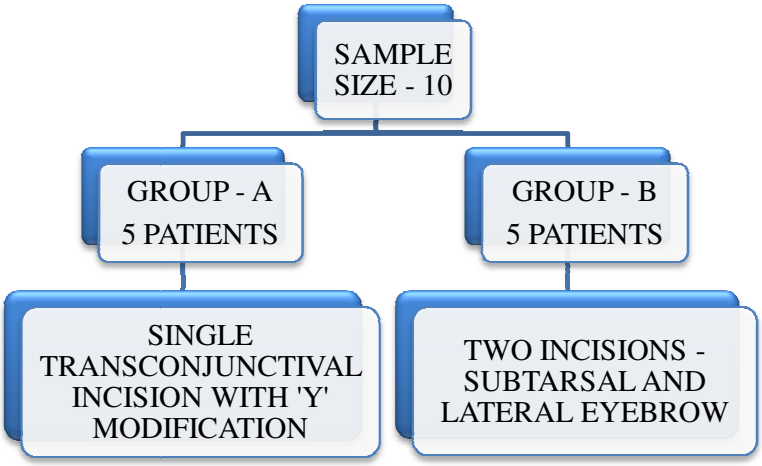
MATERIALS USED

In all patients titanium miniplates and screws were used for fixation of fractures.

1. One 2mm four hole straight miniplate in frontozygomatic region.
2. One 1.5 mm four hole curved infraorbital plate in infraorbital rim.
3. 6 mm screws were used in both infraorbital and frontozygomatic region.

The 10 patients were randomly assigned into two groups Group A and Group B and each group consisted of 5 patients. The group A patients was assigned as A1, A2, A3, A4, A5 and group B was assigned as B1, B2, B3, B4, B5 respectively. All the

cases were treated within 10 days of trauma. In Group A, patients were treated with preseptal transconjunctival approach with cutaneous 'Y' – modification for exposure of both infraorbital rim and frontozygomatic area through a single incision and in Group B, patients were treated by subtarsal skin-muscle flap approach for exposure of infraorbital rim and lateral eyebrow incision for exposure of frontozygomatic region i.e. two cutaneous incision were used. In both groups, the zygoma was reduced by



Dingman's approach and two point fixation done in frontozygomatic and infraorbital rim with titanium miniplates and screws. The muscle layer was not sutured in Group - B. Frost sutures was placed in Group - A patients 1 week postoperatively. Antibiotics and steroid eye drops was prescribed to all patients post operatively in Group A. Pressure dressing was placed in all patients post-operatively.

PARAMETERS ASSESSED

The parameters which were assessed intraoperatively were the intraoperative time taken for each approach and the ease of surgical exposure.

INTRAOPERATIVE TIME

Intraoperatively, the time for incision was calculated from the beginning of the incision to the exposure of the fracture site. For group – B patients the total time taken for subtarsal and lateral eyebrow incision was calculated.

EASE OF SURGICAL EXPOSURE

The ease of surgical access and the adequacy of exposure was assessed by the surgeon. The values for exposure was given as 1 – if the exposure was not adequate and difficulty has encountered in fractures reduction and fixation, 2 – if exposure is adequate for fracture reduction and fixation, 3 – if the exposure is found to be excellent.

Patients were monitored periodically every week for first month and then reviewed at the end of second and third month. At the end of third month other parameters like fracture reduction, mouth opening, infraorbital nerve paresthesia, scar assessment and any other complications were noted.

FRACTURE REDUCTION AND STABILITY

Post operative evaluation of fracture reduction was assessed by PNS view and submentovertex view taken within a week of surgery. CT scans were taken 3 months after surgery and pre operative and post operative CT scans were compared to assess the accurate reduction of fracture segments and the stability of fixation.

Mouth Opening

The preoperative maximal interincisal opening (MIO) was defined as the distance between the incisal edges of the maxillary and mandibular incisors at the

time of admission. An MIO less than 35 mm, or the width of three fingers, was considered to be limited mouth opening and indicative of trismus.

Infraorbital Nerve Paresthesia

In all patients the infraorbital nerve paresthesia was assessed pre and post operatively by verbally asking the patients for signs of altered, tingling, pricking sensation or numbness in the infraorbital area, upper lip and upper anterior teeth.

Symmetry of Face

The symmetry of face preoperatively and postoperatively was assessed clinically and by comparing the photographs taken in the birds and worms view.

SCAR ASSESMENT

Post operatively, the scar assessment was done after 3 months, and the scar was evaluated by 4 persons – two by the oral and maxillofacial surgeons and two by the non medical personnel. The scar was given a scale from 0 to 4.[52]

SCAR ASSESSMENT VALUE	INFERENCE
0	Not visible
1	Barely visible
2	Noticeable
3	Very noticeable
4	Extremely noticeable

PATIENT SATISFACTION SCALE:

The patient was given a scale of 1 to 3 for their opinion regarding the cosmetic outcome of the procedure. The satisfaction score was adopted from the article by Gray et al in 1994. [67]

PATIENT SATISFACTION SCORE	INFERENCE
1	Not satisfied
2	Satisfied
3	Very satisfied

COMPLICATIONS

The patients were evaluated for any complications like wound infection., dehiscence, plate exposure/ need for plate removal and ocular complications like ectropion, entropion, scleral show, edema, chemosis, lateral canthal ligament displacement, lower lid malposition, lagopthalmus, epiphora, keratoconjunctivitis, lacrimal sac injury, laceration of skin of lower eyelid.

FIG. 4 ARMAMENTARIUM

Surgical procedure

SURGICAL PROCEDURE

After ruling out head, cervical spine and ophthalmic injuries, the patients were planned for open reduction and internal fixation based upon their clinical and radiographic assessment. All patients were treated under general anesthesia through nasoendotracheal tube intubation.

GROUP – A : TRANSCONJUNCTIVAL 'Y' MODIFICATION INCISION

Preparation of the surgical site

After intubation, in supine position, with head tilted to the opposite side of fracture, the surgical area was painted with povidone iodine and draped using sterile drapes. A forced duction test was performed at the beginning and at the end of the surgery.

Marking of incision

Disposable plastic Corneal shield was placed to prevent any injury to the globe. A 'Y'-shaped incision (fig. 5) was marked on the lateral aspect of the lateral canthal region following a skin crease.

Injection of vasoconstrictor

Saline with epinephrine(1: 200,000-vasoconstrictor) infiltrated subcutaneously below the marked incision i.e. in the lateral canthus region and across the inferior orbital rim.

Traction sutures

The lower eyelid was everted with fine forceps and 3 traction sutures were passed through the eyelid ensuring that the tarsal plate is included in the suture. This was done to help with the lid retraction and used as a Frost suture on completion of the surgery.

Incision

- Incision was made through skin and subcutaneous tissue (fig 6) until the orbicularis oculi muscle is identified.
- Next, the incision was taken through the orbicularis oculi muscle, and blunt dissection was performed under the muscle with a curved hemostat in a preseptal fashion following the infraorbital rim, ending just lateral to the lacrimal punctum
- Canthotomy of the inferior limb of the lateral canthal ligament (fig. 7) was performed with small scissors; this provides more access to the lateral orbit.
- With 1 arm of the scissors placed inside the tunnel and the other arm on the outside of the conjunctiva, incision of the conjunctiva was made inferior to the lower tarsal plate.
- A subperiosteal dissection was carried out to expose the insertion of the common LCT in the Whitnall's tubercle.
- Cantholysis of the LCT was finished, and normal subperiosteal dissection was done to expose all affected areas.
- The cutaneous 'Y' would transform into a box when retracting its corners, increasing the working area (fig. 8) and allowing access of the zygomatic-frontal (ZF) suture, lateral orbital wall, body of the zygoma, infraorbital rim, and floor of the orbit with a single incision.

Fracture reduction and fixation

Reduction of fractures done by Dingman's approach by inserting an Rowe's zygomatic elevator posterior to the lateral wall of orbit. The reduction at zygomaticosphenoid suture assessed intraoperatively for accurate reduction. Then,

two point fixation was done in the frontozygomatic region and infrorbital rim with titanium miniplates and screws (fig. 9). The intraoperative stability of the fractures was then checked and was found to be satisfactory.

Canthotomy and closure

Layerwise closure done as shown in fig. 10

- The common portion of the lateral canthal ligament was secured back in its original position, should be placed as posteriorly and superiorly as possible. 2-0 vicryl suture was used for this purpose.
- Then, the closure of periosteum and orbicularis muscle covering the lateral orbit was done with 3 - 0 vicryl.
- Conjunctiva was then sutured with 5 - 0 monocryl. Continuous locking suturing was done and the knots were buried to prevent any irritation to the eye.
- After this, the inferior limb of the LCT was repositioned and sutured to the common LCT, making sure that there was no overlapping or steps in the shape of the lateral cant. This was done with 3-0 prolene.
- Finally the skin is sutured in the original Y shape with 4 – 0 prolene sutures.

The corneal shield was removed followed by copious rinses with saline solution and positioning of the Frost suture by use of the previously placed sutures in the lower eyelid.

GROUP B : SUBTARSAL AND LATERAL BROW APPROACH

Preparation of the surgical site

After intubation, in supine position, with head tilted to the opposite side of the fracture, surgical area was painted with povidone iodine and draped using sterile

drapes. A forced duction test was performed at the beginning and at the end of the surgery.

Marking of incision

The subtarsal incision was made 5 to 7 mm inferior to the lower lid margin, in one of the subtarsal creases, and extends laterally into (or parallel to) one of the resting skin tension lines located along the lateral aspect of the orbit.

After palpating the step deformity in frontozygomatic area, a incision less than 2 cm is marked within the confines of the lateral eyebrow parallel to the superior lateral orbital rim.

Injection of vasoconstrictor

Saline with epinephrine(1: 200,000-vasoconstrictor) infiltrated subcutaneously below the marked incisions in the inferior orbital rim and frontozygomatic region.

Incision

The skin incision (fig. 11) was made along the marking, through skin and dissection through the orbicularis oculi was done and a preseptal dissection is carried to the level of the orbital rim. The periosteum just below the infraorbital rim was incised to reveal the orbital floor and infraorbital rim. This approach maintains a band of pretarsal orbicularis muscle as well as its innervations on the tarsus.

A lateral eyebrow incision was made along the marking of the incision already made and by palpating the step deformity in the frontozygomatic region. Layer wise dissection was done and finally the periosteum incised after palpating the supraorbital rim to expose the fracture site (fig. 12).

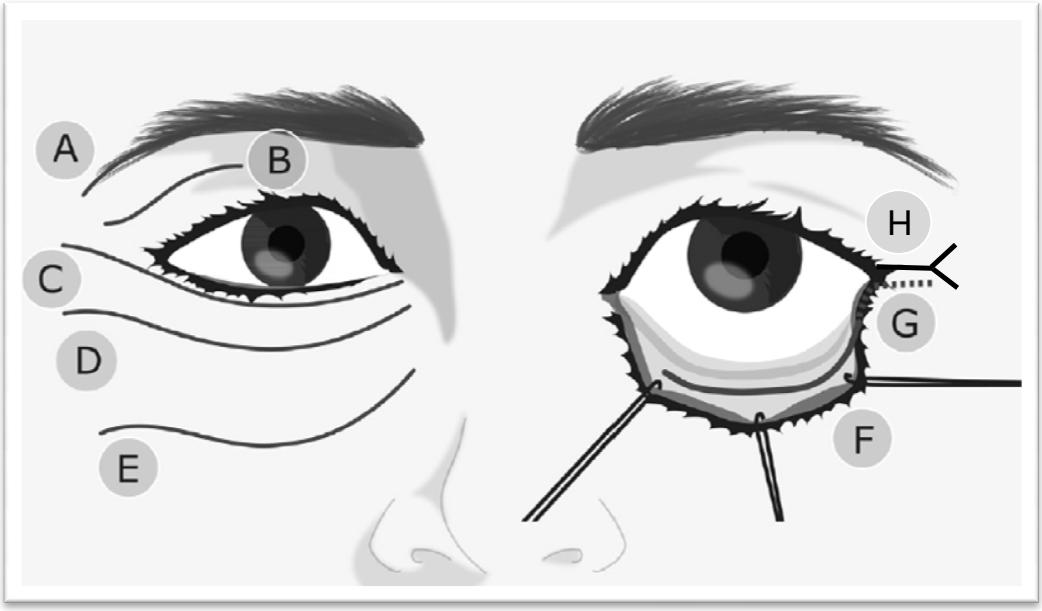
Fracture reduction and fixation

Once the fracture site exposed, reduction of fractures done by Dingmans approach by inserting an Rowe's zygomatic elevator posterior to the lateral wall of orbit and after adequate reduction, two point fixation was done in the frontozygomatic and infraorbital rim with titanium miniplates and screws (fig. 13).

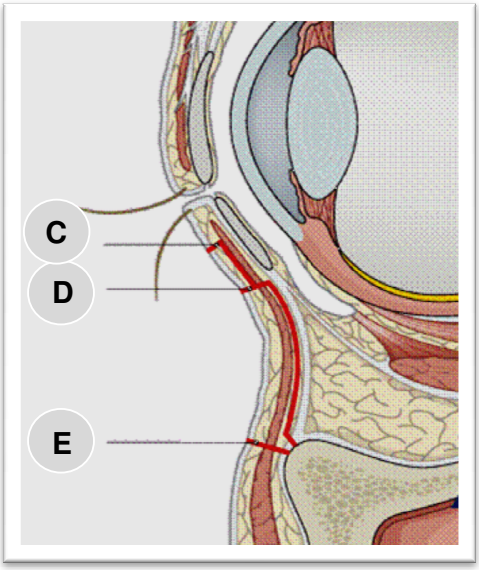
Closure

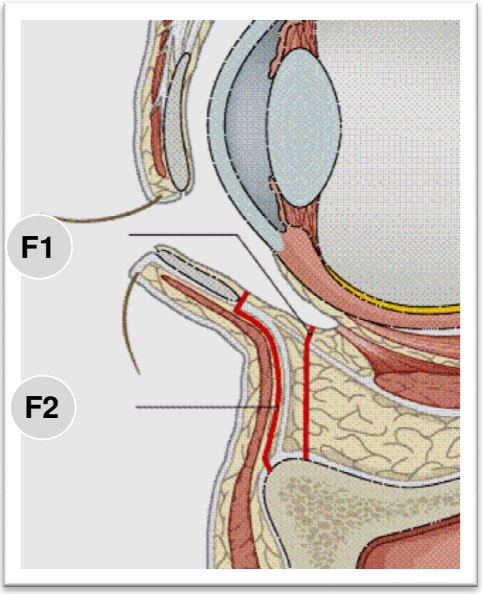
Layer wise closure done. Periosteum is closed in both incisions with 3-0 vicryl. The muscle layer was not sutured in the subtarsal incision to prevent chances of ectropion. Skin closure done by subcuticular suturing with4-0 prolene (fig. 14).

FIG. 3 INCISIONS IN MANAGEMENT OF ZMC FRACTURES – FRONTAL AND SAGITTAL VIEW



Courtesy : Rodrigo Otavio Moreira Marinho, Belini Freire-Maia, Management of Fractures of the Zygomaticomaxillary Complex. Clinics of North America 2013; 25(4) : 617-636.





A. Lateral eyebrow
B. Upper blepharaplasty
C. Sub ciliary
D. Subtarsal
E. Infraorbital
F. Transconjunctival
F1 – Transconjunctival retroseptal
F2 – Transconjunctival preseptal
G. Lateral canthotomy
H. Y modificaiton

GROUP – A TRANSCONJUNCTIVAL 'Y' MODIFICATION

FIG. 5 MARKING OF INCISION

FIG. 6 SKIN INCISION

Fig. 7 LATERAL CANTHOTOMY AND INFERIOR CANTHOLYSIS

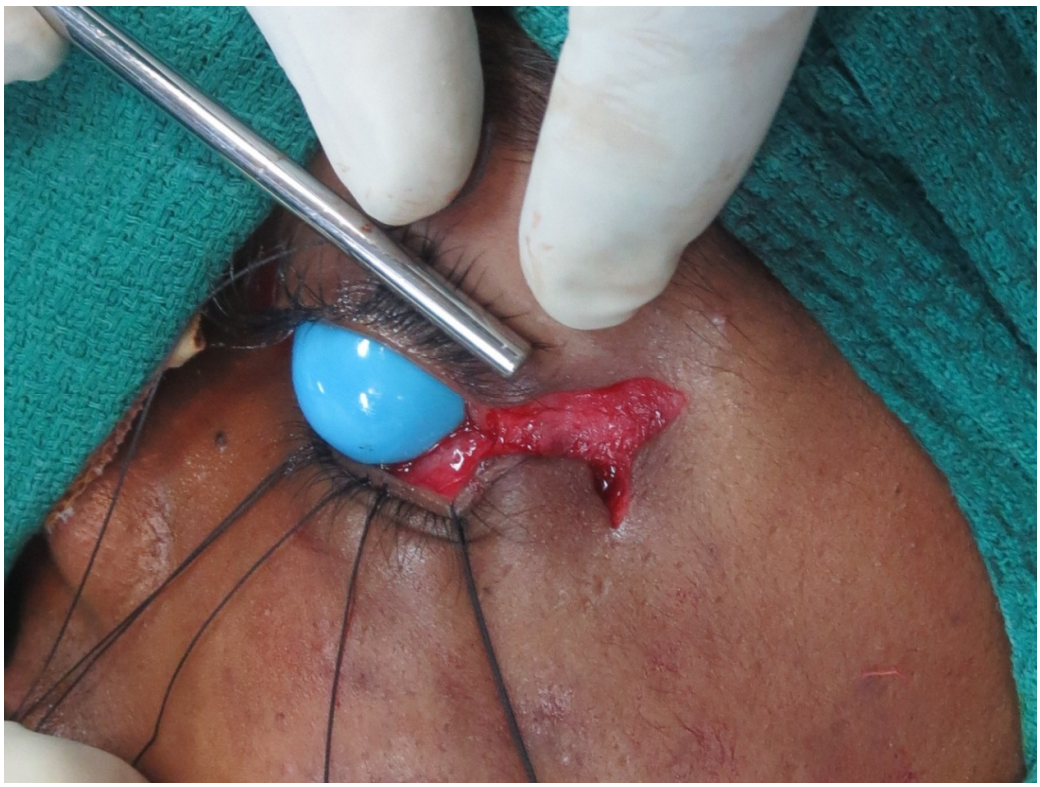


Fig. 8 EXPOSURE OF FRACTURE SITE – SINGLE INCISION

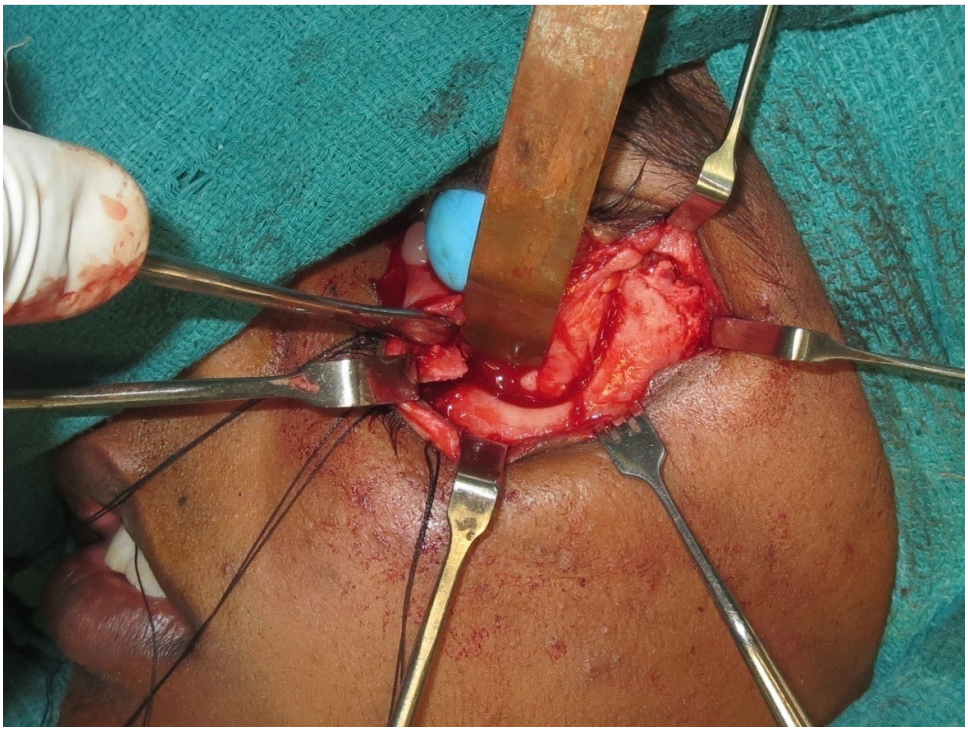


Fig. 9 FIXATION OF FRACTURES THROUGH SINGLE INCISION

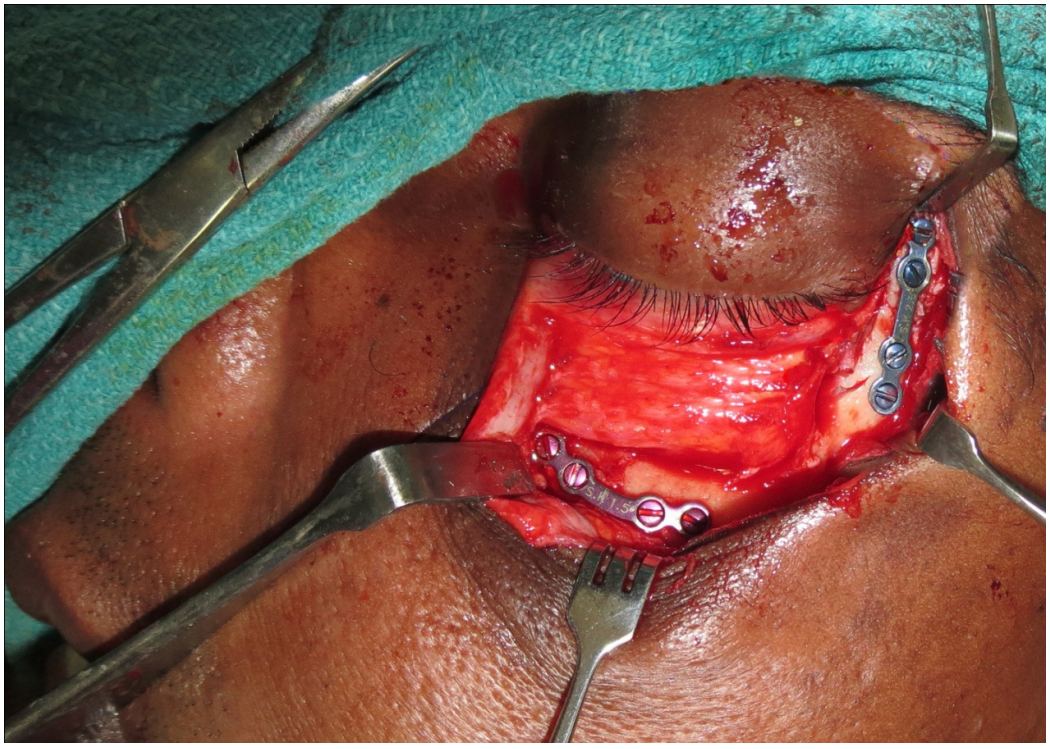


Fig. 10 LAYERWISE SUTURING

GROUP – B – SUBTARSAL LATERAL EYEBROW APPROACH

Fig. 11 INCISION

Fig. 12 EXPOSURE OF FRACTURE SITE

Fig. 13 FIXATION OF FRACTURES

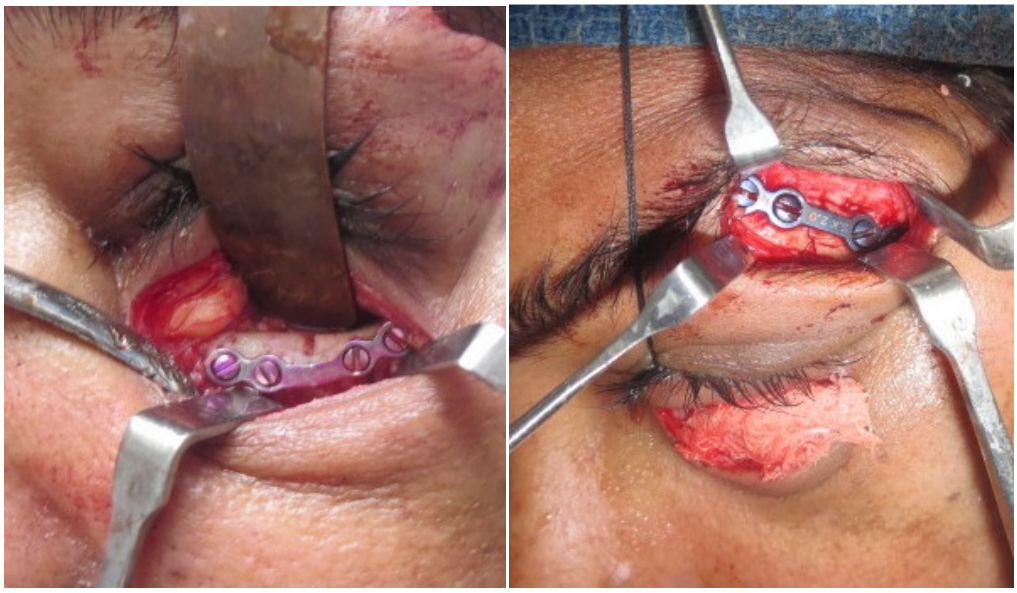


Fig. 14 CLOSURE

GROUP A – PATIENT 1

PATIENT : A1 **OP. NO : 010790**

AGE / SEX : 23 Years / Male

CHIEF COMPLIANTS : Swelling and pain in right side of face for past two days.

MODE OF INJURY : Hit by ball while playing cricket

PAST MEDICAL/ SURGICAL HISTORY : Not relevant.

CLINICAL EXAMINATION

EXTRAORAL : Subconjunctival haemorrhage – right eye

Circumorbital ecchymosis – right eye

Facial asymmetry – depression in right side of face

Step deformity and tenderness in right infraorbital rim, right frontozygomatic region and right zygomatic arch

Mouth opening – adequate – 43 mm

INTRAORAL : Occlusion - normal

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view

CT scan – axial, coronal, sagittal with 3D reconstruction.

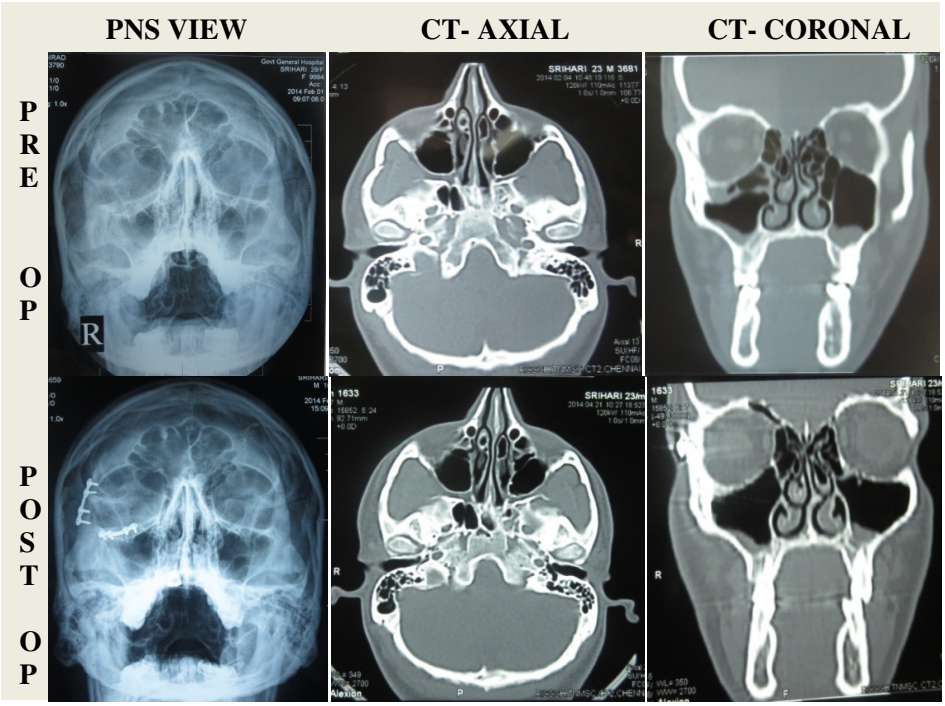
DIAGNOSIS : Fracture Right Zygomaticomaxillary complex

SURGERY DONE : ORIF – Two point fixation by transconjunctival approach with cutaneous Y modification.

INTRAOPERATIVE COMPLICAITONS : None

POSTOPERATIVE COMPLICATIONS : None

FIG. 15 GROUP – A - PATIENT – A1 - FRACTURED RIGHT ZMC



GROUP A – PATIENT 2

NAME : A2 **OP. NO : 013137**

AGE / SEX : 29 Years / Male

CHIEF COMPLIANTS : Pain in left side of face for past five days.

MODE OF INJURY : RTA – Bike Vs Bike

PAST MEDICAL/ SURGICAL HISTORY : Not relevant.

CLINICAL EXAMINATION

EXTRAORAL : Subconjunctival haemorrhage – left eye

Circumorbital ecchymosis – left eye

Facial asymmetry – depression in left side of face

Step deformity and tenderness in left infraorbital rim, and left maxillary buttress.

Mouth opening – adequate – 42 mm

Paresthesia over left infraorbital region.

INTRAORAL : Occlusion - normal

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view

CT scan – axial, coronal, sagittal with 3D reconstruction.

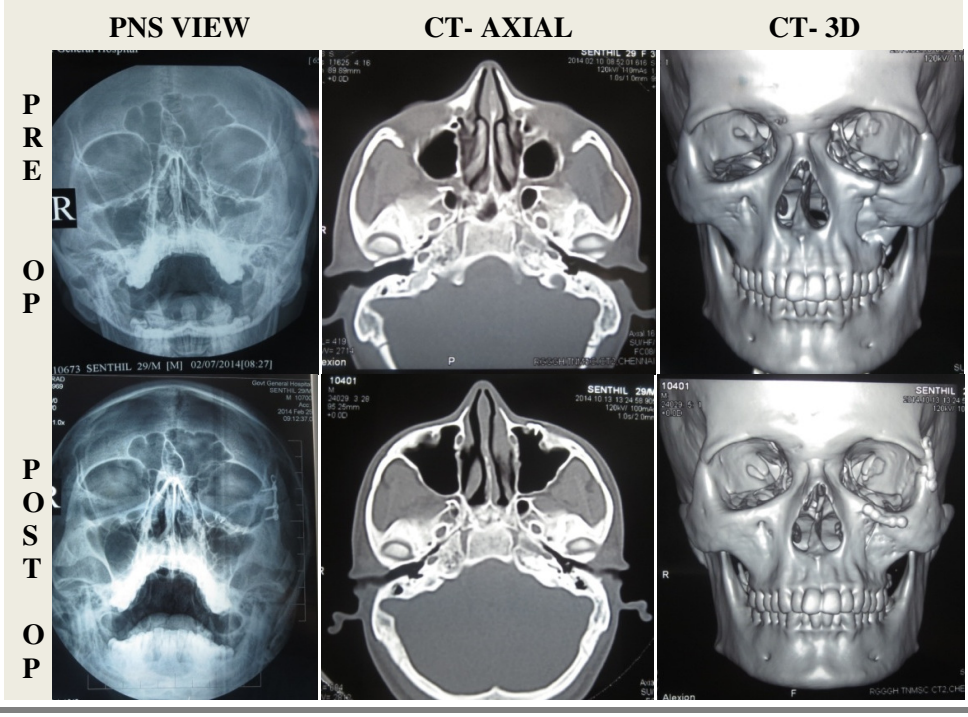
DIAGNOSIS : Fracture left Zygomaticomaxillary complex

SURGERY DONE : ORIF – Two point fixation by transconjunctival approach with cutaneous Y modification.

INTRAOPERATIVE COMPLICATIONS : None

POSTOPERATIVE COMPLICATIONS : None

FIG. 16 GROUP – A - PATIENT – A2 - FRACTURED LEFT ZMC



GROUP A – PATIENT 3

NAME **:** A3 **OP. NO :** 050271

AGE/ SEX **:** 30 Years / Male

CHIEF COMPLIANTS **:** Swelling and pain in left side of face for past one days.

MODE OF INJURY **:** Assault by known persons

PAST MEDICAL/ SURGICAL HISTORY **:** Not relevant.

CLINICAL EXAMINATION

EXTRAORAL **:** Subconjunctival haemorrhage – Left eye.

Circumorbital ecchymosis – Left eye.

Facial asymmetry – Swelling in left side of face.

Step deformity and tenderness in left infraorbital rim, left frontozygomatic region and left zygomatic buttress.

Mouth opening – restricted – 20 mm.

INTRAORAL **:** Occlusion – normal.

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view.

CT scan – axial, coronal, sagittal with 3D reconstruction.

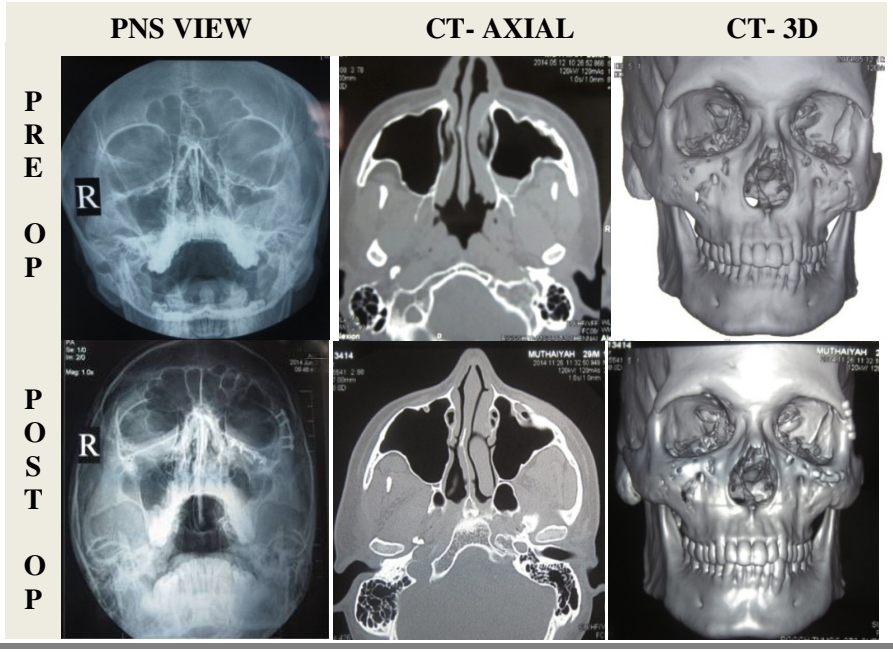
DIAGNOSIS **:** Fracture left Zygomaticomaxillary complex

SURGERY DONE **:** ORIF – Two point fixation by transconjunctival approach with cutaneous Y modification.

INTRAOPERATIVE COMPLICATIONS : None

POSTOPERATIVE COMPLICATIONS : Lower Eyelid Malposition

FIG. 17 GROUP – A - PATIENT – A3 - FRACTURED LEFT ZMC



GROUP A – PATIENT 4

NAME : A 4 **OP. NO : 068721**

AGE / SEX : 18 Years / Male

CHIEF COMPLIANTS : Pain in left side of face for past three days.

MODE OF INJURY : RTA – self fall from two wheeler

PAST MEDICAL/ SURGICAL HISTORY : Not relevant.

CLINICAL EXAMINATION

EXTRAORAL : Subconjunctival haemorrhage – Left eye.

Facial asymmetry – Depression in left side of face.

Step deformity and tenderness in left infraorbital rim, left frontozygomatic region and left maxillary buttress.

Mouth opening – restricted – 24 mm.

Paresthesia over left infraorbital region.

INTRAORAL : Occlusion – normal.

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view

CT scan – axial, coronal, sagittal with 3D reconstruction.

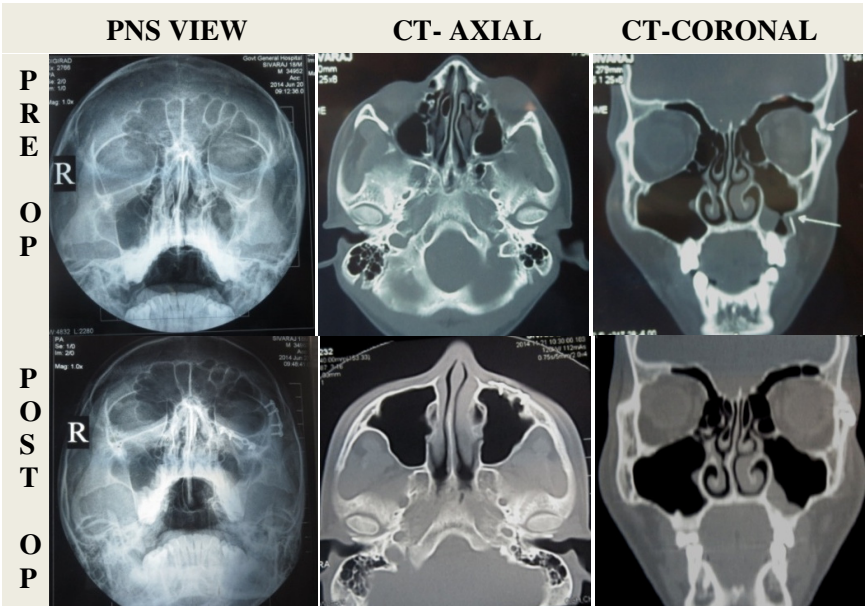
DIAGNOSIS : Fracture left Zygomaticomaxillary complex

SURGERY DONE : ORIF – Two point fixation by transconjunctival approach with cutaneous Y modification.

INTRAOPERATIVE COMPLICATIONS : Lower lid laceration.

POSTOPERATIVE COMPLICATIONS : None

FIG. 18 GROUP – A - PATIENT – A4 - FRACTURED RIGHT ZMC



GROUP A – PATIENT 5

PATIENT : A5 **OP. NO : 083409**

AGE / SEX : 23 Years / Male

CHIEF COMPLIANTS : Pain in left side of face for past five days.

MODE OF INJURY : RTA – Bike Vs Bike

PAST MEDICAL/ SURGICAL HISTORY : Not relevant.

CLINICAL EXAMINATION

EXTRAORAL : Subconjunctival haemorrhage – left eye.

Facial asymmetry – depression in left side of face.

Step deformity and tenderness in left infraorbital rim, and left frontozygomatic region.

Mouth opening – restricted – 30 mm.

Paresthesia over left infraorbital region.

INTRAORAL : Occlusion - normal

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view

CT scan – axial, coronal, sagittal with 3D reconstruction.

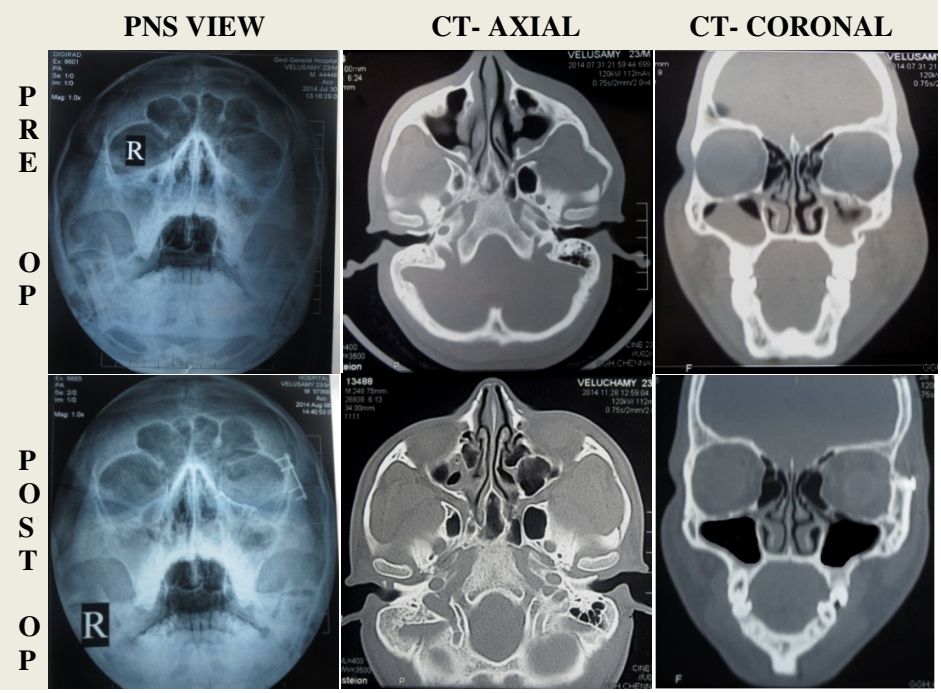
DIAGNOSIS : Fracture left Zygomaticomaxillary complex

SURGERY DONE : ORIF – Two point fixation by transconjunctival approach with cutaneous 'Y' modification.

INTRAOPERATIVE COMPLICATIONS : None.

POSTOPERATIVE COMPLICATIONS : None.

FIG. 19 GROUP – A - PATIENT – A5 – FRACTURED LEFT ZMC



GROUP B – PATIENT 1

NAME : B 1 **OP. NO :** 088633

AGE/ SEX : 39 Years / Female

CHIEF COMPLIANTS : Swelling and pain in left side of face for past two days.

MODE OF INJURY : RTA – self fall from two wheeler.

PAST MEDICAL/ SURGICAL HISTORY : Not relevant.

CLINICAL EXAMINATION

EXTRAORAL : Subconjunctival haemorrhage – Left eye

Circumorbital ecchymosis – Left eye

Facial asymmetry – Swelling in left side of face

Step deformity and tenderness in left infraorbital rim, left frontozygomatic region and left zygomatic buttress.

Mouth opening – restricted – 20 mm.

Paresthesia over left infraorbital region.

INTRAORAL : Occlusion – normal.

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view.

CT scan – axial, coronal, sagittal with 3D reconstruction.

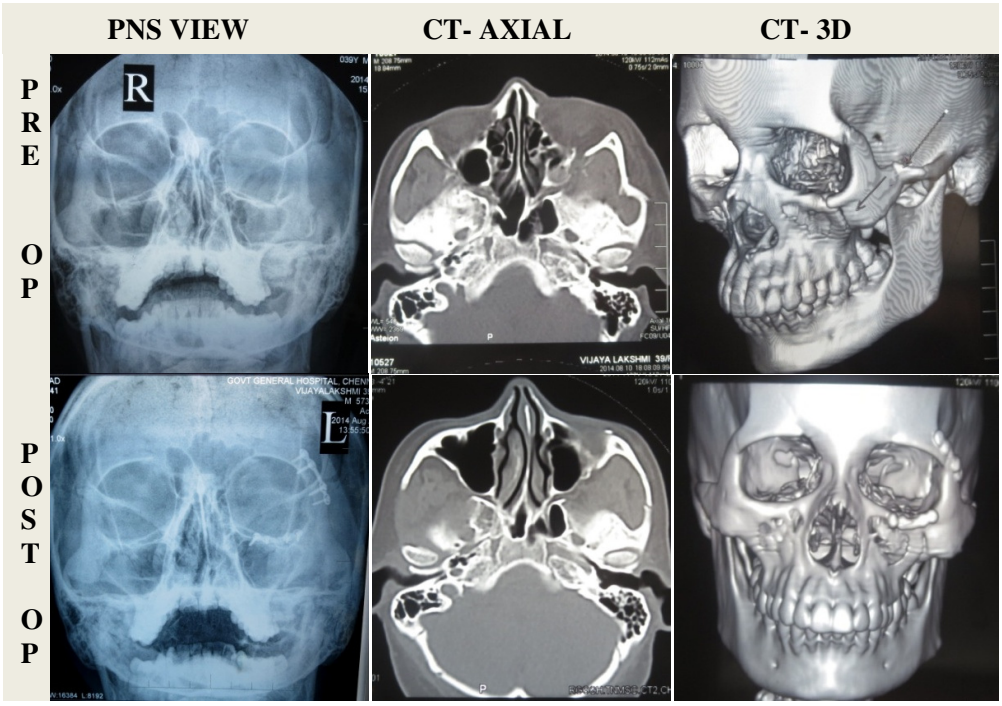
DIAGNOSIS : Fracture left Zygomaticomaxillary complex.

SURGERY DONE : ORIF – Two point fixation by subtarsal and lateral eyebrow approach.

INTRAOPERATIVE COMPLICATIONS : None.

POSTOPERATIVE COMPLICATIONS : None.

FIG. 20 GROUP – B - PATIENT – B1 - FRACTURED LEFT ZMC



GROUP B – PATIENT 2

PATIENT : B2 **OP. NO :** 070401

AGE/ SEX : 32 Years / Male

CHIEF COMPLIANTS : Swelling and pain in left side of face for past four days.

MODE OF INJURY : RTA – 4 wheeler Vs Lorry

PAST MEDICAL/ SURGICAL HISTORY : Not relevant.

CLINICAL EXAMINATION

EXTRAORAL : Subconjunctival haemorrhage – Left eye

Circumorbital ecchymosis – Left eye

Facial asymmetry – Swelling in left side of face

Sutured wound over left upper eyelid.

Step deformity and tenderness in left infraorbital rim, left frontozygomatic region and left zygomatic buttress.

Mouth opening – Restricted- 25 mm

Paresthesia in left infraorbital region.

INTRAORAL : Occlusion - normal

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view

CT scan – axial, coronal, sagittal with 3D reconstruction.

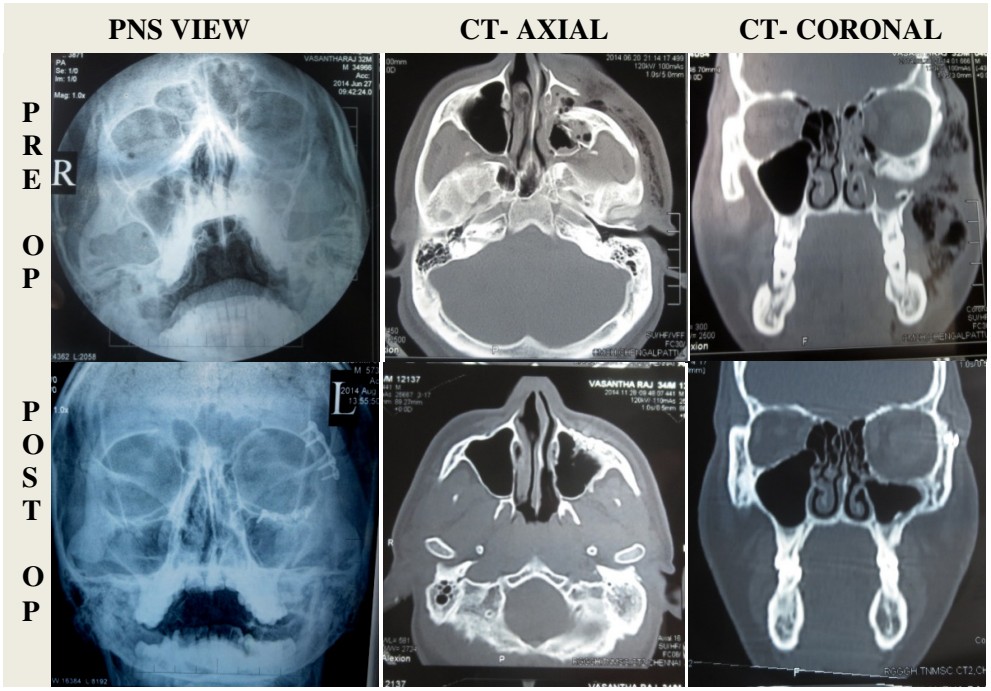
DIAGNOSIS : Fracture left Zygomaticomaxillary complex

SURGERY DONE : ORIF – Two point fixation by subtarsal and lateral eyebrow approach.

INTRAOPERATIVE COMPLICATIONS : None

POSTOPERATIVE COMPLICATIONS : None

FIG. 21 GROUP – B - PATIENT – B2 - FRACTURED RIGHT ZMC



GROUP B – PATIENT 3

PATIENT : B3 **OP. NO :** 081430

AGE/ SEX : 35 Years / Female

CHIEF COMPLIANTS : Swelling and pain in left side of face for past three days.

MODE OF INJURY : RTA – two wheeler Vs Car

PAST MEDICAL/ SURGICAL HISTORY : Not relevant.

CLINICAL EXAMINATION

EXTRAORAL : Subconjunctival haemorrhage – left eye

Circumorbital ecchymosis – left eye

Scar – left cheek

Facial asymmetry – depression in left side of face

Step deformity and tenderness in left infraorbital rim, left frontozygomatic region and left zygomatic buttress

Mouth opening – adequate - 42 mm

Paresthesia over left infraorbital region

INTRAORAL : Occlusion - normal

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view

CT scan – axial, coronal, sagittal with 3D reconstruction.

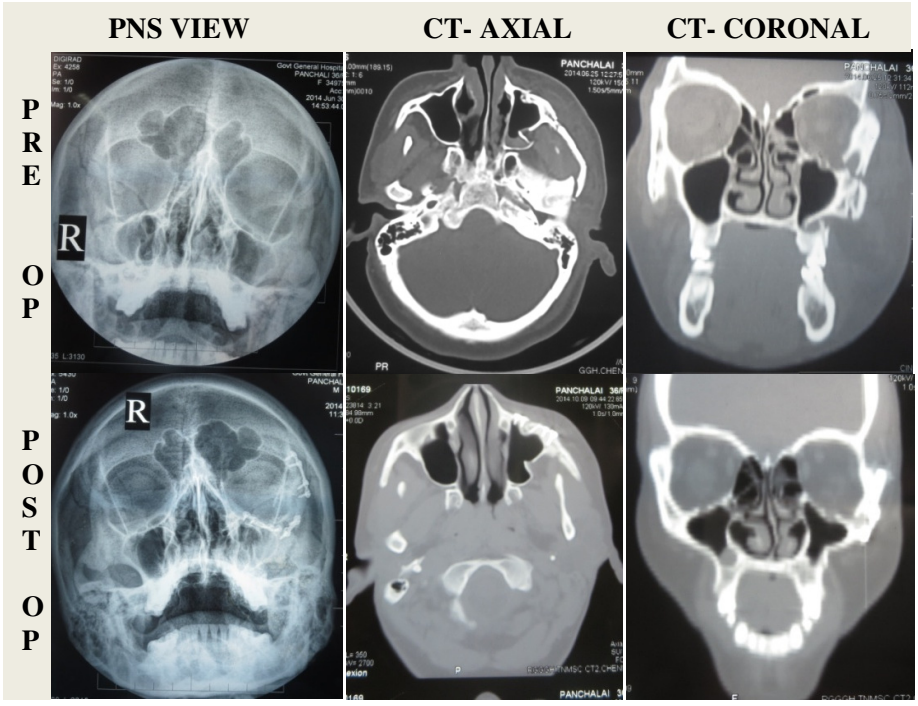
DIAGNOSIS : Fracture left Zygomaticomaxillary complex

SURGERY DONE : ORIF – Two point fixation by subtarsal and lateral eyebrow approach.

INTRAOPERATIVE COMPLICATIONS : None.

POSTOPERATIVE COMPLICATIONS : Facial Asymmetry

FIG. 22 GROUP – A - PATIENT – A1 - FRACTURED RIGHT ZMC



GROUP B – PATIENT 4

NAME : B 4 **OP. NO :** 084163

AGE/ SEX : 30 Years / Male

CHIEF COMPLIANTS : Difficulty in opening the mouth for past five days.

MODE OF INJURY : RTA –Two wheeler Vs two wheeler

PAST MEDICAL/ SURGICAL HISTORY : Not relevant.

CLINICAL EXAMINATION

EXTRAORAL : Subconjunctival haemorrhage – left eye

Facial asymmetry – depression in left side of face

Step deformity and tenderness in left infraorbital rim, left frontozygomatic region.

Mouth opening – adequate - 43 mm.

INTRAORAL : Occlusion – normal.

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view

CT scan – axial, coronal, sagittal with 3D reconstruction.

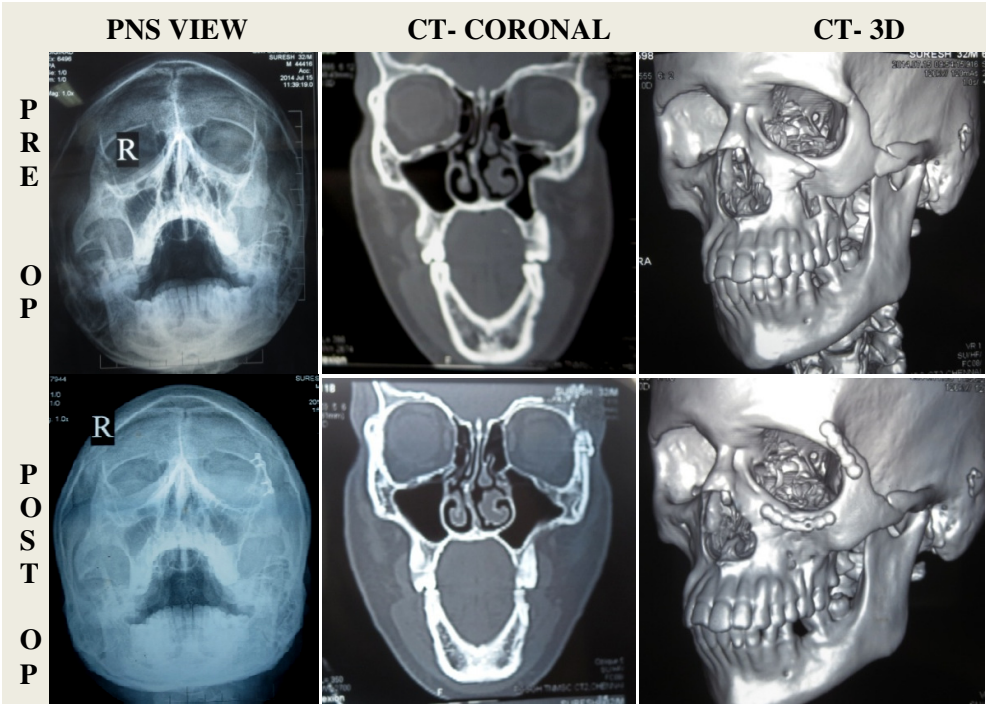
DIAGNOSIS : Fracture left Zygomaticomaxillary complex

SURGERY DONE : ORIF – Two point fixation by subtarsal and lateral eyebrow approach.

INTRAOPERATIVE COMPLICATIONS : None

POSTOPERATIVE COMPLICATIONS : None

FIG. 23 GROUP – B- PATIENT – B4 - FRACTURED LEFT ZMC



GROUP B – PATIENT 5

PATIENT : B5 **OP. NO :** 010839

AGE/ SEX : 32 Years/ Male

CHIEF COMPLIANTS : Pain in the left side of face for past two days.

MODE OF INJURY : RTA – Self fall from two wheeler.

PAST MEDICAL/ SURGICAL HISTORY : Not relevant.

CLINICAL EXAMINATION

EXTRAORAL : Subconjunctival haemorrhage – left eye

Scar in the left forehead.

Step deformity and tenderness in left infraorbital rim and left zygomatic buttress.

Mouth opening – restricted – 27 mm

INTRAORAL : Occlusion - normal

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view

CT scan – axial, coronal, sagittal with 3D reconstruction.

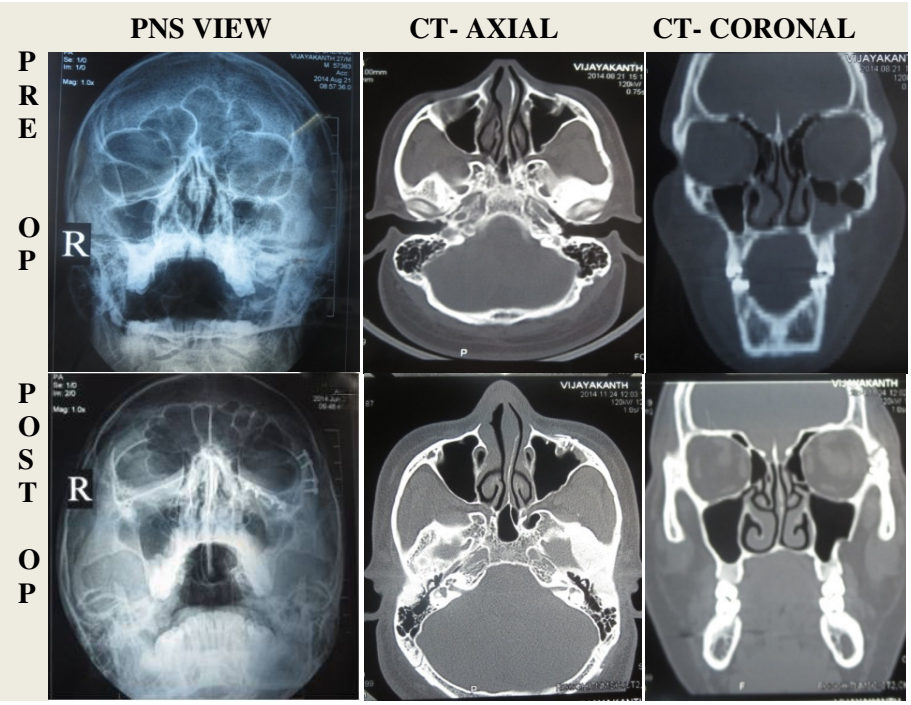
DIAGNOSIS : Fracture left Zygomaticomaxillary complex

SURGERY DONE : ORIF – Two point fixation by subtarsal and lateral eyebrow approach.

INTRAOPERATIVE COMPLICATIONS : None.

POSTOPERATIVE COMPLICATIONS : None.

FIG. 24 GROUP – B - PATIENT – B5 - FRACTURED RIGHT ZMC



Observation & Results

OBSERVATION AND RESULTS

Ten patients were treated with two point fixation in frontozygomatic region and infraorbital rim with two different surgical approaches and the following parameters were compared.

- Intraoperative time for both approaches.
- Ease of surgical access.
- Fracture reduction
    - Symmetry of face restored postoperatively.
    - Improvement in mouth opening
    - Resolution of infraorbital nerve paresthesia
- Cosmetic outcome by scar assessment
- The post operative complications using both technique.

*All these datas were analysed by **SPSS** (software package for statistical analysis) version 18.*

INTRAOPERATIVE TIME

The intraoperative time was evaluated from the beginning of the surgery to the exposure of the fracture site. The mean time for Group A patients was **18.80 ± 1.92** with a Standard deviation(SD) of 1.92 minutes and for Group B patients it was **22.8 ± 1.92 (SD- 1.92)** minutes. In group B patients the total time taken for lateral eyebrow incision and subtarsal incision was considered. ***Independent Sample t Test*** was used to compare the intraoperative times and ***p value was 0.01*** (Table 1) and found to be ***significant***.

EASE OF SURGICAL ACCESS

The ease of surgical access was rated by the surgeon depending on the exposure of fractures, ease in fracture reduction and fixation. The values for Group–A and Group – B was compared and the ***'p' value*** was found to be ***0.035*** **(Table 3)** which was ***significant.***

FRACTURE REDUCTION AND STABILITY

Fracture reduction was evaluated by comparing the preoperative and postoperative CT scan. The ***symmetry*** of the face post operatively was assessed clinically as well as by comparing the pre operative and the post operative photographs in birds view and in worms view. Of the ten patients, in nine cases the symmetry of the face was restored post –operatively. In one patient which belonged to Group – B asymmetry was present postoperatively which may be attributed to inadequate fracture reduction. Out of 60% of patients with ***infraorbital nerve paresthesia***, 30% had recovered after surgery in 3 months follow up but in 30% of patients the symptoms improved following surgery but the recovery was not complete. Preoperatively 60% of patients had difficulty in ***mouth opening***. Postoperatively, in all patients optimal mouth opening was achieved with an average mouth opening of **43.8 ± 3.77 (SD – 3.77)** mm in group A and **44.2± 1.64 (SD – 1.64)** mm in group B. (Table 4 and Table 5)

The Post op mouth opening achieved after surgery, resolution of infraorbital nerve paresthesia and fracture reduction between Group – A and Group – B was compared statistically and there was no significant difference between two groups. (Table 6)

SCAR ASSESSMENT

The scar was assessed by 4 observers, 2 maxillofacial surgeons and 2 non medical personnel (fig. 25,26). The average of all four readings were calculated for each patient. (Table 8, 9, 10) In group B, scar in both subtarsal and lateral eyebrow region was assessed separately and average was taken for each patient. The scar score was compared using ***Chi square test*** and the ***p value was 0.306*** *(Table 12, Chart 4)****which was not significant***. None of the patient had any hypertrophic scar.

The patient satisfaction score for the scar was evaluated and the comparison between Group – A and Group – B was done by ***chi square test*** (Table 13, Chart 5)and the ***p value was found to be 0.36, which was not significant.***

COMPLICATIONS

In none of the patients any wound infection or dehiscence nor any need for plate removal occurred. None of the patients had complications related to incision like ectropion, entropion, corneal abrasion, enopthalmus, shortening of lower eyelid or chronic edema.

In Group A – one patient had lower eyelid malposition which may be attributed to the inadequate replacement of the lateral canthal tendon to its original position or improper suturing in the lateral canthus. Another patient Group A lower lid laceration occurred intraoperatively, for which suturing was done and healing occurred without any obvious scar.

In Group B – facial asymmetry was present in one patient due to inadequate reduction which may be attributed to the limited exposure in subtarsal-lateral eyebrow approach.

CHART 1 : SEX DISTRIBUTION OF ZMC FRACTURES IN THE STUDY

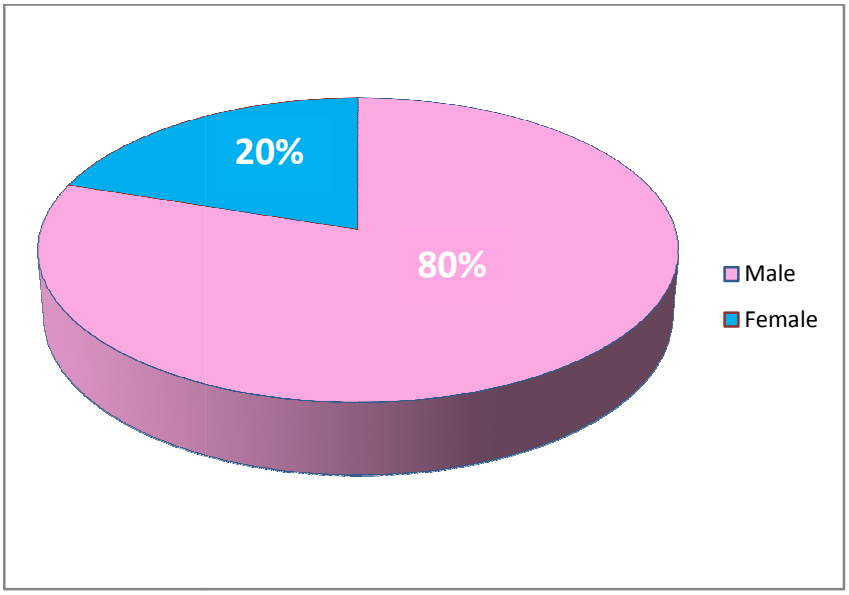
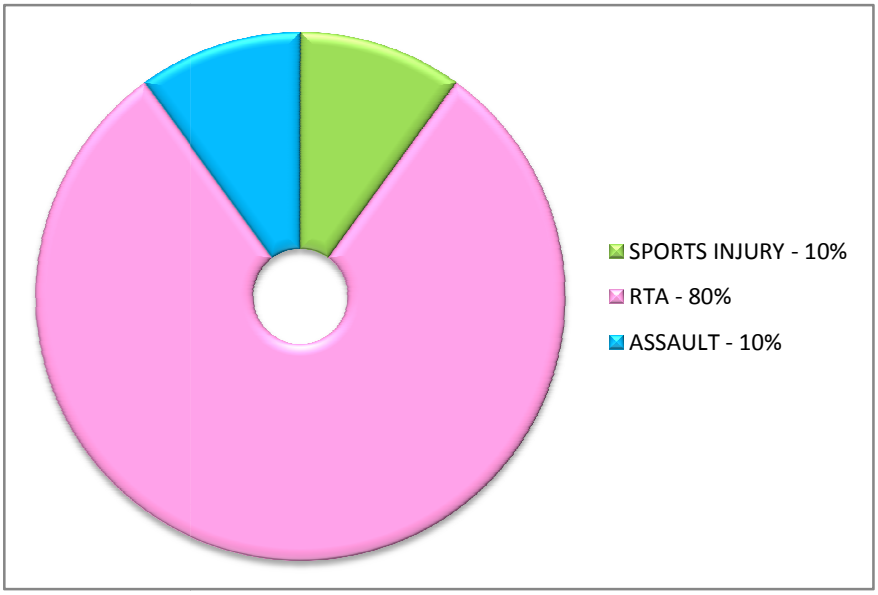


CHART 2 : ETIOLOGY OF ZMC FRACTURES IN THE STUDY



Group A patients - A1, A2, A3, A4, A5 Group B patients - B1, B2, B3, B4, B5

TABLE 1 : AGE / SEX DISTRIBUTION, ETIOLOGY, SURGICAL TECHNIQUE AND COMPLICATIONS IN GROUP – A AND GROUP – B

CASE	AGE / SEX	SIDE	MODE OF INJURY	SURGICAL TECHNIQUE	COMPLICATIONS
A1	23/M	Right	Hit by ball	Transconjunctival Y modification	None
A2	29/M	Left	RTA	Transconjunctival Y modification	None
A3	30/M	Left	Assault	Transconjunctival Y modification	Lower lid displacement
A4	18/M	Left	RTA	Transconjunctival Y modification	Laceration of lower lid
A5	23/M	Left	RTA	Transconjunctival Y modification	None
B1	39/F	Left	RTA	Subtarsal – Lateral eyebrow	None
B2	32/M	Left	RTA	Subtarsal – Lateral eyebrow	None
B3	35/F	Left	RTA	Subtarsal – Lateral eyebrow	Facial asymmetry
B4	30/M	Left	RTA	Subtarsal – Lateral eyebrow	None
B5	32/M	Left	RTA	Subtarsal – Lateral eyebrow	None

TABLE 2 : COMPARISION OF INTRAOPERATIVE TIME BETWEEN GROUP A AND GROUP B

CASE	GROUP A (SINGLE INCISION) (IN MINUTES)	GROUP B (2 INCISIONS) – IN MINUTES			P Value
		SUBTARSAL	LATERAL EYEBROW	TOTAL TIME	
1	21	18	5	23	***0.01****
2	18	16	5	21	
3	19	20	6	26	
4	16	17	5	22	
5	20	16	6	22	
MEAN ± SD	18.80 ± 1.92	17.4 ± 0.75	5.4±0.24	22.8 ± 1.92	

**Independent Sample t Test*

TABLE 3 : EASE OF SURGICAL ACCESS IN GROUP – A AND GROUP – B PATIENTS

S.NO	GROUP – A	GROUP - B	P Value
1	3	2	***0.035****
2	3	2	
3	3	1	
4	3	2	
5	3	2	

**Chi Square Test 0*

1 - Not Adequate ; 2- Adequate ; 3 – Excellent

TABLE 4 : EVALUATION OF MOUTH OPENING, INFRAORBITAL NERVE PARASTHESIA AND FRACTURE REDUCITON IN GROUP – A PATIENTS

PATIENT	MOUTH OPENING		INFRAORBITAL NERVE PARASTHESIA		POST OP FRACTURE REDUCTION
	PRE OP	POST OP	PRE OP	POST OP	
A1	43	43	A	A	ADEQUATE
A2	42	50	P	I	ADEQUATE
A3	20	42	A	A	ADEQUATE
A4	24	44	P	I	ADEQUATE
A5	30	40	P	P	ADEQUATE
MEAN ± SD	31.8 **± 10.40**	43.8 **± 3.77**	-	-	-
P Value	0.041 *		0.223**		-

****Paired Sample t test **Chi Square Test***

A –absent; p – present I - improved

TABLE 5 : EVALUATION OF MOUTH OPENING, INFRAORBITAL NERVE PARASTHESIA AND FRACTURE REDUCITON IN GROUP – B PATIENTS

PATIENT	MOUTH OPENING		INFRAORBITAL NERVE PARASTHESIA		POSTOP FRACTURE REDUCTION
	PRE OP	POST OP	PRE OP	POST OP	
B1	20	45	P	P	ADEQUATE
B2	25	42	P	I	ADEQUATE
B3	42	43	P	P	INADEQUATE
B4	43	45	A	A	ADEQUATE
B5	27	46	A	A	ADEQUATE
MEAN ± SD	31.4± 10.45	44.2± 1.64	-	-	-
P value	0.056*		0.549**		-

***Paired Sample t Test **Chi Square Test;** *A –absent; P – present I – improved*

TABLE – 6 COMPARISON OF POST OPERATIVE MOUTH OPENING, INFRAORBITAL NERVE PARSTHESIA AND ADEQUECY OF FRACTURE REDUCTION BETWEEN GROUP –A AND GROUP – B

S.NO	MOUTH OPENING		INFRAORBITAL NERVE PARASTHESIA		FRACTURE REDUCTION	
	GROUP A	GROUP B	GROUP A	GROUP B	GROUP A	GROUP B
1	43	45	A	P	A	A
2	50	42	I	I	A	A
3	42	43	A	P	A	I
4	44	45	I	A	A	A
5	40	46	P	A	A	A
MEAN ± SD	43.8 **± 3.77**	44.2**± 1.64**	-	-	-	
P value	0.056*		0.549**		1.00 ***	

****Paired Sample t test ** Chi Square Test *** Fisher Exact Test***
A –absent; p – present I - improved

TABLE 7 : FACIAL SYMMETRY EVALUATION

GROUP – A			GROUP - B			P Value For Post op Evaluation (Group A Vs Group B)
PT.	PRE OP	POST OP	PT.	PRE OP	POST OP	
A1	A	S	B1	A	S	1.00*
A2	A	S	B2	A	S	
A3	A	S	B3	A	A	
A4	A	S	B4	A	S	
A5	A	S	B5	S	S	
P value	0.008*		0.250**			

*Fisher Exact Test **Mc Nemar Test Post op Symmetry analysis:

A- asymmetry ; S – symmetry

CHART 3:COMPARISION OF FACIAL ASSYMETRY BETWEEN GROUP A AND GROUP B

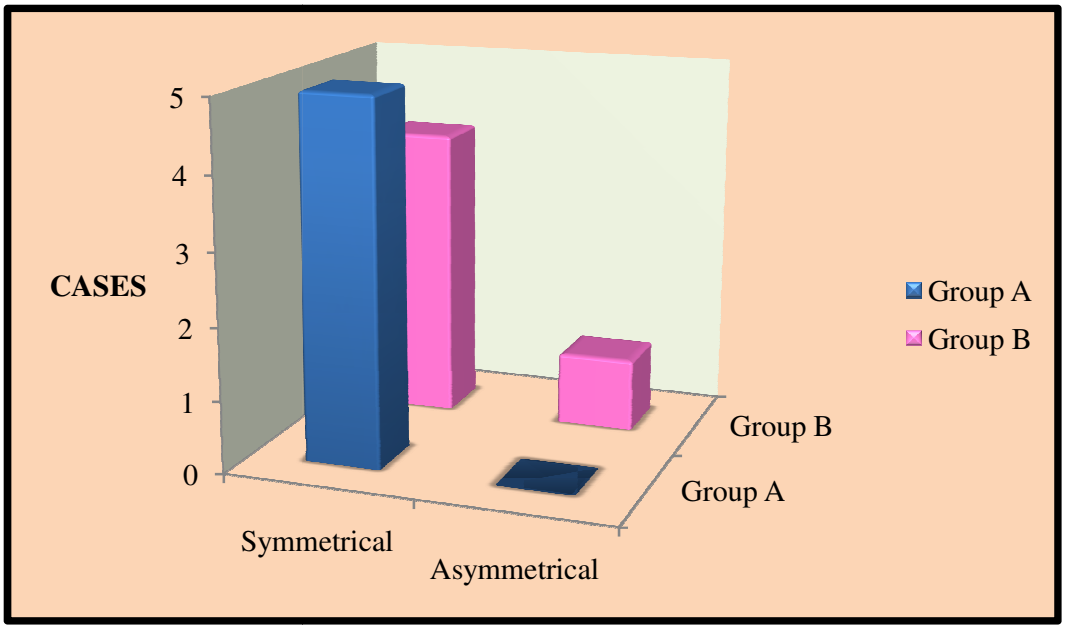


TABLE 8 : SCAR SCORE FOR GROUP –A BY FOUR OBSERVERS AND ITS MEAN GROUP – A (IN LATERAL CANTHUS REGION)

PATIENT	OBSERVER				AVERAGE
	1	2	3	4	
A1	0	0	0	0	0
A2	1	1	0	0	0.5
A3	1	1	0	0	0.5
A4	3	3	1	1	2
A5	0	0	0	0	0

SCORE : *0- Not Visible; 1-Barely Visible; 2-Noticeable; 3-Very Noticeable; 4- Extremely Noticeable;* ***RANGE :*** *0 to 0.9 – Not Visible; 1 – 1.9 – Barely Visible; 2 to 2.9 – Noticeable ; 3 to 3.9 Very Noticeable; above 4 – Extremely Noticeable.*

TABLE 9 : SCAR SCORE FOR GROUP –B (SUBTARSAL INCISION) BY FOUR OBSERVERS AND ITS MEAN

PATIENT	OBSERVER				AVERAGE
	1	2	3	4	
B1	0	0	0	0	0
B2	2	2	1	1	1.5
B3	3	3	2	2	2.5
B4	0	0	0	0	0
B5	2	2	1	1	1.5

SCORE : *0- Not Visible; 1-Barely Visible; 2-Noticeable; 3-Very Noticeable; 4- Extremely Noticeable;* ***RANGE :*** *0 to 0.9 – Not Visible; 1 – 1.9 – Barely Visible; 2 to 2.9 – Noticeable ; 3 to 3.9 Very Noticeable; above 4 – Extremely Noticeable.*

TABLE 10 : SCAR SCORE FOR GROUP –B (LATERAL EYEBROW INCISION) BY FOUR OBSERVERS AND ITS MEAN

PATIENT	OBSERVER				AVERAGE
	1	2	3	4	
B1	0	0	0	0	0
B2	2	2	1	1	1.5
B3	4	4	3	3	3.5
B4	0	0	0	0	0
B5	4	4	3	3	3.5

SCORE : *0- Not Visible; 1-Barely Visible; 2-Noticeable; 3-Very Noticeable; 4- Extremely Noticeable;* ***RANGE :*** *0 to 0.9 – Not Visible; 1 – 1.9 – Barely Visible; 2 to 2.9 – Noticeable ; 3 to 3.9 Very Noticeable; above 4 – Extremely Noticeable.*

TABLE 11 : SCAR SCORE FOR GROUP –B AVERAGE OF TWO INCISIONS

PATIENT	SUBTARSAL	LATERAL EYEBROW	AVERAGE
B1	0	0	0
B2	1.5	1.5	1.5
B3	2.5	3.5	3
B4	0	0	0
B5	1.5	3.5	2.5

SCORE : *0- Not Visible; 1-Barely Visible; 2-Noticeable; 3-Very Noticeable; 4- Extremely Noticeable;* ***RANGE :*** *0 to 0.9 – Not Visible; 1 – 1.9 – Barely Visible; 2 to 2.9 – Noticeable ; 3 to 3.9 Very Noticeable; above 4 – Extremely Noticeable.*

TABLE 12 : COMPARISION OF SCAR SCORE FOR GROUP A

AND GROUP –B

S.NO	GROUP – A	GROUP - B	P Value
1	0	0	0.306*
2	0.5	1.5	
3	0.5	3	
4	2	0	
5	0	2.5	

Chi Square Test

RANGE : 0 to 0.5 – not visible; 0.6 – 1.5 – barely visible ;1.6 to 2.5 – noticeable ; 2.6 to 3.5 very noticeable; 3.6 to 4 – extremely noticeable.

CHART 4:COMPARISION OF SCAR SCORE BETWEEN GROUP A AND GROUP B

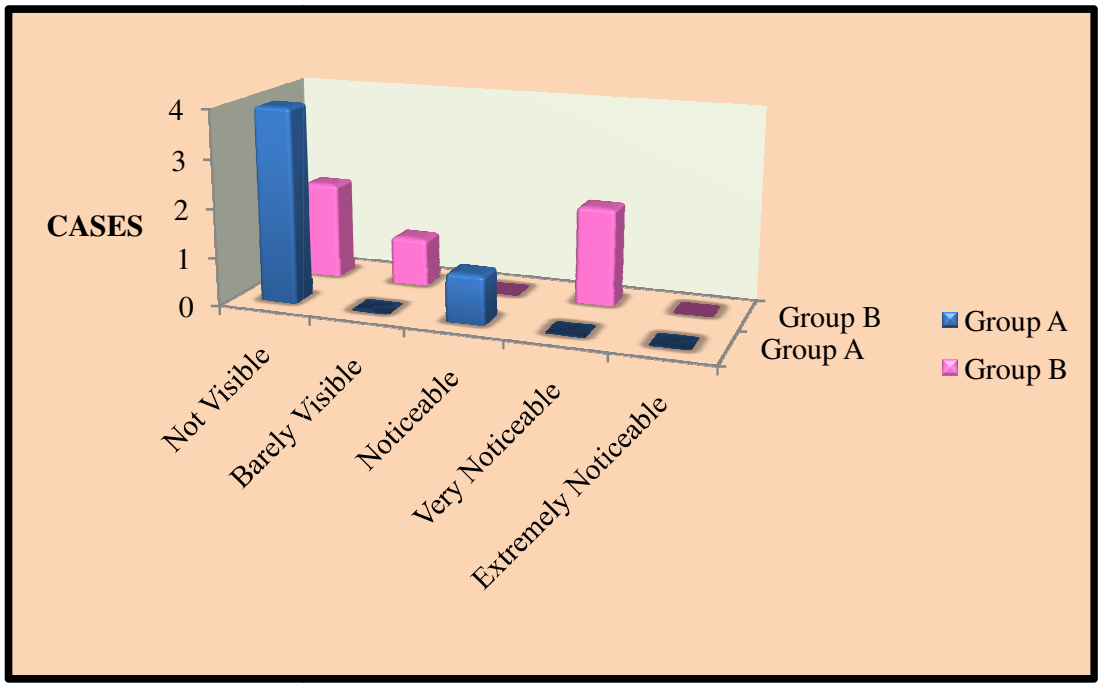


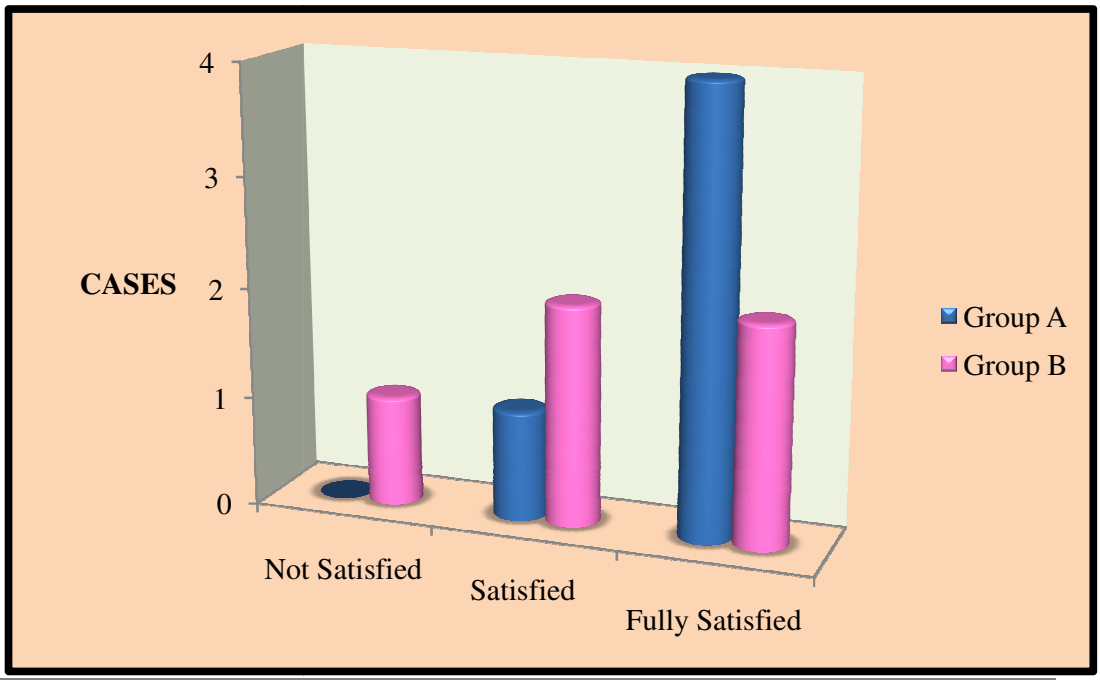
TABLE : 13 PATIENT SATISFACTION SCORE REGARDING SCAR

S.NO	GROUP – A	GROUP - B	P Value
1	2	2	0.368*
2	2	1	
3	1	0	
4	2	2	
5	2	1	

*Chi square Test

0- **NOT SATISFIED; 1- SATISFIED ; 2- FULLY SATISFIED**

CHART 5 : COMPARISION OF PATIENT SATISFACTION SCORE BETWEEN GROUP A AND GROUP B



Discussion

DISCUSSION

Various treatments suggested for ZMC fractures ranges from nonintervention, also called conservative treatment, to open reduction and internal fixation.[1] Whatever treatment is suggested, the ultimate aim is to adequately restore the anatomical form, habitual function, preventing the late visual disorders and cosmetic deformities.

The zygoma is one of the major pillars of the facial skeleton through which the occlusal forces are transmitted and distributed to the skull base. The horizontal and vertical buttress of the ZMC and orbital floors should be properly aligned during surgery, else, a variety of sequalae can occur, including enopthalmos, diplopia, rotational zygomatic displacement, midface widening and orbital dystopia. Adequate exposure is the key for proper reduction and fixation of ZMC fractures. The worst part of it is that these conditions are difficult to address with revision surgery.[57]

Literature reveals that men aged 20-30 years usually dominate in ZMC fractures (70%-80%).[88,89,90] In this study, the average age was 29.1. The male female ratio in our study was 4:1 which is similar to the study conducted by Ellis et al.[88] In this study, 80% of cases was due to road traffic accident. It is consistent with the study conducted by Covington et al who reported a 80.6 % of ZMC fractures are due to motor vehicle accidents in a ten year retrospective study.[8] This high rates of RTA may be attributed to increased traffic load as technology advances, poor road traffic laws, ignorance of traffic rules, poor conditions of the roads and vehicles, and travelling without using seat belts or helmet in developing country like India.

The most common features of ZMC fractures are per orbital ecchymosis and subconjunctival haemorrhage and was found in almost all patients in this study. According to various studies, impaired sensation of the infraorbital nerve is present in

about 50% to 90% of ZMC injuries.[91,92] In the present study infraorbital paresthesia was found in 60% of patients. A characteristic sign and striking feature of ZMC fracture is flattening of cheek which occurs in 70%- 86% of cases in a study by Larsen and Ellis et al[10,88] while in the present study malar flattening was found in 90% of cases. Trismus is another important feature of ZMC fracture which is a indication for surgical intervention. Literature reveals that about 33% to 45% of ZMC fracture cases had trismus.[88,80] In the present study trismus was noted in 60% of ZMC fractures and the mouth opening was improved for all patients postoperatively. The incidence of significant intraocular injury in patients with ZMC fractures was reported to be 14-40%. For this reason, preoperative ophthalmology consultation is essential in patients with orbital floor and ZMC fractures.[93]

Fain et al and ***Manson et al*** reported that fixation is essential for preventing rotation of the zygomatic bone, and the stability can be achieved with miniplates in one or two points, with no need for fixing it in three or four points, other than in cases of comminuted fractures.[42] ***Rinehart et al*** reported that the instabilities in ZMC fractures are directly attributed to the masseter muscles action, and concluded that there was no rotation of the zygomatic bone when simulating action of masseter muscle forces in ZMC fractures when fixed in two points: frontozygomatic suture and infraorbital rim.[15] Thus correlating with the above studies, and the fracture involved in the present study was simple tetrapod fractures, we decided two point fixation for all patients involved in this study.

When there are multiple acceptable methods to access a problem, there often arises a controversy, which occurs in relation to orbital approaches. Approaches that results in a visible scar are obsolete and if possible they should be avoided in facial

fractures. Postoperative morbidity, minimal risk of complications, operative time and excellent exposure of the fractures are variables that define the method of choice. Access to the infraorbital rim is usually carried out by transcutaneous approaches like subciliary, subtarsal and infraorbital or transconjunctival. It is believed that the transcutaneous access should be held as close to the ciliary margin to avoid a visible scar process, but far enough to minimize exposure of sclera and ectropion, making subtarsal an acceptable procedure.[94] Literature reveals that complications and benefits of transconjunctival and subtarsal approach are almost equivalent, so we preferred to compare these two approaches in the management of ZMC fractures. Also, in literature, though a plenty of studies published comparing various incisions, most of the studies were conducted for treatment of orbital floor fractures. This study is unique in that, this is the first study to compare the incision techniques for management of ZMC fractures and also, we used cutaneous 'Y' modification in transconjunctival approach as described by Alan[7] which is a new technique.

The evolution of single incision for two point fixation in ZMC fractures has an interesting history.[63,64,66,67,68,69] Earlier days upper blepharoplasty or lateral eyebrow incision was used for frontozygomatic fixation and subciliary, subtarsal, transconjunctival or infraorbital approaches were used for infraorbital rim fixation. Surgeons in the midseventies utilized the lateral portion of the upper lid blepharoplasty incision for frontozygomatic and lower lid blepharoplasty incision including subciliary or transconjunctival approaches for infraorbital rim fixation which produced superior scars. When utilizing both the upper and lower blepharoplasty incisions simultaneously in zygomatic fracture treatment, it was apparent that only a small bridge (4 to 7 mm) of skin that existed between the lateral limbs of the upper and lower blepharoplasty incisions. Beneath the skin, the only

structure separating them is the lateral canthal ligament. So, if the lateral canthal ligament is mobilized then it is possible to use single incision to expose zygomaticofrontal suture as well as the lower orbit and zygoma through a single incision. Thus, in connecting both the incisions, evolved the single incision technique for exposure of both frontozygomatic and infraorbital rim and it was first McCord and Moses describe the addition of the lateral canthotomy to gain access to the. zygomatic frontal buttress as early as 1979.[57] Thus the entire lateral orbit is routinely exposed, confirming alignment of the zygoma and the integrity of the greater wing of the sphenoid.

Since its evolution numerous studies were conducted on single incision technique. Manson et al[43] further championed the single incision approach with a large series reported in 1987. Westfall et al also emphasized the minimal complication rate of the single incision technique in more than 1200 cases. This approach allows access to repair virtually any inferior, lateral, and most medial rim fractures as well as all floor defects. Equally important is that the addition of the lateral canthotomy affords direct visualization of the most anterior projection of the zygoma, which is critical for symmetric repair.[95]

When a decision is made upon transconjunctival approach, there are two different techniques: retroseptal and preseptal. Most authors use retroseptal approach in blepharoplasty procedures and in treatment of orbital floor fractures, since it provides direct access to the orbital floor.[71,96] The advantage of the direct exposure of the orbital fat in a lower-lid blepharoplasty, is considered to be a disadvantage in fracture repositioning. A retroseptal approach is more useful in blepharoplasties and

preseptal approach would be a better option for fracture reduction and fixation. So, we decided to go with preseptal transconjunctival approach for all cases in Group A.

Intraoperative Time

In a study conducted by Girish et al the time required for the transconjunctival approach with lateral canthotomy was 18.9 minutes while from the subciliary approach it was 16 minutes and they found that it was statistically significant .[97] Holtmann et al. concluded that the subtarsal lid crease incision was the fastest, with average skin-to-fracture exposure time of 5–8 min. The subciliary incision was developed in 15 min, whereas the transconjunctival incision took 20 min to complete.[74] Balanand et al reported that 8 minutes for infraorbital, 10 minutes for subtarsal and 22 minutes for transconjunctival with lateral canthotomy approach.[98]

In this study the average time taken for transconjunctival Y modification was - 18.80 minutes and the time taken for combined subtarsal lateral eyebrow approach was 22.8 minutes and the difference was statistically significant (p value - 0.01). Since single incision is used, the transconjunctival 'Y' modification technique took significantly less time and found to be superior in terms of rapidity.

Exposure

The important advantage of this single incision technique is that both the fractures in the frontozygomatic and infraorbital rim can be visualized simultaneously, thus adequate reduction can be achieved. Also, the lateral wall of the orbit and zygomaticosphenoid suture can be clearly visualized, which is considered to be a critical area to assess the fracture reduction. Another important advantage of the 'Y' modification is that when proper lateral extension is placed, it can be retracted to visualize the body of zygoma, which is possible only with the coronal incision.

Ilankovan et al put forward that simultaneous visualization of the infraorbital rim and lateral orbital rim is great advantage of this technique as opposed to any other method.[99] Exposure was considered excellent for fixation in all cases in group – A using single incision, but one case in Group – B the exposure was not adequate, ultimately leading to inadequate fracture reduction. There was significant difference in the amount of exposure between groups, and clearly the transconjunctival 'Y' modification technique is superior in terms of exposure.

Fracture Reduction-Facial symmetry, Infraorbital Nerve Paresthesia, mouth opening

By comparing the pre op and post op CT scans, the fracture reduction was found to be satisfactory in all cases in Group – A, but one case in Group – B the fracture reduction was not satisfactory owing to the inadequate exposure by two incision technique. This led to ***facial asymmetry*** in this patient.

Schilli et al reported that in 95% of ZMC fractures, the fracture lines involve the infraorbital foramen and may cause some degree of sensory disturbance.[100] According to the literature the incidence of ***infraorbital nerve paresthesia*** in ZMC fractures ranges from 30 to 80%.[91,92,101,102] The nerve can be damaged secondarily to a blunt, crush-type of injury, or by a bony compression of the nerve at the fracture site as it leaves the infraorbital foramen. Denman et al concluded that after miniplate osteosynthesis only 22.1% had persistent neurological sequelae.[91] In our study the infraorbital paresthesia was found in 60 % of cases and it resolved in 30% of cases after 3 months of follow up, in the remaining 30% of cases the symptoms were improving by time, but there was no complete resolution. In all patients postoperatively adequate ***mouth opening*** was achieved.

Postoperatively, there was no significant difference between Group – A and Group – B patients in terms of fracture reduction, resolution of infraorbital nerve paresthesia and mouth opening.

Scar Assessment

The rate of perceiving a noticeable scar was reported slightly higher for the subtarsal approach when compared with the transconjunctival approach (2.2% Vs none).[103] Holtman showed that the scar formed by subtarsal approach is almost imperceptible.[74] Many authors confirmed that when lateral canthotomy is used, it leads to minimum of scar tissue, and the range of complication is very low [66,71,72] Also, the study by sanosh et al confirmed that the lateral canthotomy scar was not objectionable by the patient.[62]

In this study the average scar score for Group – A is 0.6 and the average scar for Group – B patients is 1.4.. In Group – A one patient had scar which is very noticeable. This may be attributed to the relatively young age of the patient involved in this study for whom the skin creases were not prominent. In case of old age patients the scar will not be visible and is usually camouflaged by the existing skin creases.

Though there was no statistically significant difference in scar scores between two groups, the scar in the transconjunctival 'Y' modification was superior but the subtarsal scar and the lateral eyebrow scar were visible in some patients.

COMPLICATIONS - GROUP – A

In Group – A patients two patients had complications which includes one case of lower lid malposition and one case of lower lid laceration.

Lower Lid Malposition

It is an accepted fact that when combined with a lateral canthotomy, exposure is excellent with the transconjunctival approach. However, the addition of a lateral canthotomy significantly complicates the approach because the inferior canthus has to be properly resuspended during closure to prevent eyelid malpositions. In fact, the reattachment of the inferior canthus is perhaps the most exacting and difficult part in the entire approach.

Experience has shown that canthal reattachment is not required in acute fracture cases, but it is necessary in fractures in which the treatment is delayed or in patients whom a simultaneous coronal incision is employed.[43] There are two known techniques for repositioning of the LCT, either the superficial inferior limb of the LCT may be sutured to the deep component of the LCT or holes may be drilled in the frontozygomatic region and the LCT may be secured to this hole with the help of sutures. In this study one patient in Group – A had lower eyelid malposition(fig. 28) in spite of repositioning the superficial inferior limb of the LCT to the deep component. This might be due to inadequate repositioning of LCT or improper suturing of eyelid in the lateral canthus region. But the malposition was very mild that the patient did not had any issues regarding the condition, it was noticeable only to the surgeons on careful examination. Since the patient is satisfied with the cosmetic results, we decided that any kind of revision surgery is not required for this patient.

Laceration Of Lower Eyelid

The other common complication of transconjunctival approach is the laceration of lower eyelid. Wray et al reported one case of lower lid laceration in their study and they attributed it to the excessive traction on the lid.[71] In our study the laceration of the lower eyelid (fig. 27) was encountered inadvertently while incising

the conjunctiva. The laceration was very small, so one suture with 4 – 0 prolene was placed after the completion of procedure. The laceration healed well and in three months of follow up, the scar was almost imperceptible. This is learning curve for us, that the tissues have to be manipulated carefully during surgery and any such complication should be avoided in future.

COMPLICATIONS - GROUP - B

Facial asymmetry

According to literature, the facial asymmetry after surgical management of ZMC fractures may occur in 20 to 40% of the cases in rigid internal fixations.[48] The facial asymmetry following surgery is related to the time taken to conduct the surgical reduction, and to the failure in obtaining adequate surgical access for exploration and fixation of the fracture sites. In this study one patient (20%) had facial asymmetry in Group – B postoperatively which could be attributed to inadequate fracture reduction (fig. 29) due to the difficulty in obtaining an adequate surgical exposure through the subtarsal lateral eyebrow approach.[48]

OTHER COMPLICATIONS

Ectropion for subtarsal approaches has been reported to be ranging from 2.7% to 7.7%.[74,103] Wray et al[74] reported 42% of incidence of ectropion after the subciliary approach compared with no ectropion after the transconjunctival approach. In the study of Appling et al.[72], the incidence of permanent scleral show was 28% after the subciliary approach and 3% after transconjunctival approach. Manson et al[43] quoted ectropion and scleral show occur in inverse proportion to the experience of the operator. A recent metaanalysis was conducted, in which seventeen studies were included, representing 2086 patients. The risk of ectropion was highest in subciliary

incisions (14 percent), the risk of entropion was highest in transconjunctival incisions (1.5 percent), and the risk of hypertrophic scarring was highest in subtarsal incisions (3.4 percent). A majority of these complications resolved with conservative management.[104]

In our study none of the patients complications like cicatricial scarring ectropion, entropion or sclera show. In all cases frost suture was placed postoperatively, we believed use of frost suture produces superior traction, which encourages the lower eyelid redraping in proper anatomic position.

There are many factors related to the surgical technique that may prevent the occurrence of ectropion and sclera show, such as[105]

1. Avoidance of deep lateral dissection of orbicularis oculi muscle.
2. Meticulous attention to hemostasis.
3. Correct incision of the periosteum on the anterior surface of the rim, away from the orbital septum.
4. Avoidance of the wide dissection of the anterior periosteum.
5. Use of suspensory suture or frost suture.
6. Importantly, stepped skin muscle flap.

In all our cases we used plastic corneal shield to protect the globe. So none of the patients had any globe injuries like corneal abrasion. Though an infrequent occurrence, one problem which threatens all postoperative patients is infection. Zachariades et al reported that *0.8% of* infections occurred in the mid face fracture fixations and included that the most common type of infection was sinusitis followed by preseptal cellulitis and dacryocystitis.[97] In this study that none of the patients had

any infection following surgery. This may be attributed to the sound aseptic techniques followed as well as the sample is too small for an infection to occur.

Subtarsal - Lateral Eyebrow Versus Transconjunctival

The most important advantage of the transconjunctival 'Y' modification is that the simultaneous visualization of the frontozygomatic and infraorbital rim through the same incision which aids in accurate fracture reduction and excellent esthetics. The disadvantages of this approach is that it requires retraction and manipulation of the conjunctival surfaces, making the ocular globe more susceptible to injury, also the conjunctiva is a profoundly unique tissue that has few acceptable substitutes for repair and reconstruction. The repositioning of the LCT is more demanding procedure requiring experience and it is difficult for the beginners.

A significant advantage of the subtarsal approach is its simplicity. With direct visualization, the anatomy of the lower lid and orbit are easily identified during dissection, treatment, and closure. The lateral eyebrow incision is also very simple and direct, it is safe even with an inexperienced surgeon as it does not involve any vital structures in this region. But the disadvantage with this technique is that since two incisions are used the exposure is less and difficulty is encountered during fracture reduction. Also when compared with the transconjunctival technique the scar is visible and the complications like scleral show and ectropion are more common with subtarsal approach.

Summary and Conclusion

SUMMARY & CONCLUSION

"Difficult roads often leads to beautiful destination"

No consistent approach for ZMC fractures has gained universal acceptance. Precise repair of fractures of the zygomaticomaxillary complex requires four essential features: a thorough understanding of the regional anatomy, accurate and precise diagnosis, unimpeded exposure and rigid fixation of fractures to restore it to the premorbid form. In surgeons perspective, the selection of incision is quite important since adequate exposure is the key to success in surgery and once made the scar is not easily revised. Advances in imaging techniques, surgical technique, and materials for fixation have allowed for improved functional and aesthetic outcomes in management of ZMC fractures.

In our study, subtarsal lateral eyebrow approach had shown less morbidity, lesser risk of complications except the inadequate exposure in one case since two cutaneous incisions were used. Though the subtarsal approach provide excellent esthetic results, when combined with lateral eyebrow approach the amount of exposure and the scar created by the lateral eyebrow approach is inferior to the single transconjunctival 'Y' modification technique.

The transconjunctival 'Y' modification is surgically superior in providing exposure and access, and also aesthetically superior to other approaches and has minimal complications. The potential advantages of this approach negate the longer time taken for this approach. The complication with this technique may be minimized if performed meticulously with sound knowledge of anatomy of the periorbital tissues. In our experience, the transconjunctival 'Y' modification is most effective for two point fixation through single incision.

Though this study is conducted on a small sample, from this study, it may be emphasized that the subtarsal approach may be advocated for orbital floor fractures with excellent results, but when it comes to two point fixation in ZMC fractures it is better to use transconjunctival 'Y' modification approach, as it involves a single incision, the intraoperative time for exposure is less, exposure is good, both the fracture sites can be simultaneously visualized for accurate fracture reduction and also has excellent cosmetic results. The only factor which is of concern is that, this approach is technically demanding, needs surgical expertise and meticulous handling of the tissues.

Neither the transconjunctival nor the transcutaneous approaches are immune from complications. Given that all approaches have the potential for postoperative sequelae, the approach selection should be customized according to the needs of each patient and should balance the perioperative risks with the requirements of treatment. The approach must also be based, in part, on the ability of the surgeon to not only perform the approach but also to manage the complications that might result.

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Annexures

INFORMED CONSENT

"COMPARISION OF Y- MODIFICATION OF TRANSCONJUNCTIVAL APPROACH VERSUS SUBTARSAL – LATERAL EYEBROW APPROACH FOR ZYGOMATICOMAXILLARY COMPLEX FRACTURES - A PROSPECTIVE STUDY"

Patient's Identification No: _____Patient's Name: _____

Patient's DOB: _____ _____ _____
DD MM YYYY

I confirm that I have read and understood the Information Sheet for the above study. I have had the opportunity to ask questions and all my questions and doubts have been answered to my complete satisfaction.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected.

I understand that the Clinical study personnel, the Ethics Committee and the Regulatory Authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to the third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study.

I agree not to withhold any information about my health from the investigator and will convey the same truthfully.

I agree to take part in the above study and to comply with the instructions given during the study and to faithfully co-operate with the study team and to

immediately inform the study staff if I suffer from any deterioration in my health or wellbeing or any unexpected or unusual symptoms.

I am aware that my jaw fracture can be treated by temporarily immobilizing the jaws for 6 weeks with wires. I was explained about the surgical methods (under local or general anesthesia) of treating the jaw fracture using plates and screws and chose the surgical option on my own wish. I was also informed about the side effects of this surgical procedure and I hereby consent to participate in this study.

I consent to give my medical history, undergo complete physical examination and diagnostic tests including hematological, biochemical and urine examination etc.

Signature / Thumb Impression : _____ Place:_____ Date._____

Patient's Name & Address : _____

_____

Signature of the Investigator : _____ Place:_____ Date_____

Study Investigator's Name : _____

Institution : _____

* Signature of the Witness : _____ Place:_____ Date_____

* Name & Address of the Witness : _____

_____

* Mandatory for uneducated patients (Where thumb impression has been provided above)

<u>சுய ஒப்புதல் படிவம்</u>

<u>ஆய்வு செய்யப்படும் தலைப்பு :</u> கன்ன எலும்பு, மேல் தாடை கூட்டு முறிவில் இரண்டு அறுவை சிகிச்சை முறையை ஒப்பு நோக்குதல்.

ஆராய்ச்சி நிலையம் : அரசு பல் மருத்துவ கல்லூரி
சென்னை . 600 003

பங்கு பெறுபவரின் பெயர் :

பங்கு பெறுபவரின் எண் :

பங்கு பெறுபவரின் பிறந்த தேதி : _____ / _____/ _____
தேதி மாதம் வருடம்

இப்படிப்பு சம்பந்தமாக நான் மேலே கூறப்பட்ட தகவல் படிவத்தை முழுமையாக படித்துப் பார்த்தேன் என்று உறுதி கூறுகிறேன்.

நான் இது தொடர்பான அனைத்து கேள்விகளுக்கும் நிறைவான பதில்கள் பெறப்பட்டேன்.

இந்த ஆய்வில் எனது பங்கு தன்னிச்சையானது என்றும் எந்த நேரத்திலும் இந்த ஆய்வில் இருந்து சட்ட உரிமைகள் பாதிக்கப்படாமல் விலகிக்கொள்ள சம்மதிக்கிறேன்.

மருத்துவ ஆய்வு அதிகாரிகள். எனது சிகிச்சை தொடர்பான பதிவேடுகளை பார்வையிட சம்மதிக்கிறேன். எனது அடையாள குறிப்புகள் மூன்றாவது நபருக்கு தெரிவிக்கப்படமாட்டாது என்று புரிந்துகொண்டேன்.

பொது மயக்க மருந்து கொடுத்து உடைந்து உள்ள முக எலும்பை தகடு மற்றும் திருகுகள் வைத்து அறுவை சிகிச்சை செய்து கொள்ள ஒப்புதல் அளிக்கிறேன்.

இந்த ஆய்வு அறிக்கைகளைப் பயன்படுத்தவும், வெளியிடவும் நான் சம்மதிக்கிறேன். ஆய்வாளர் எனது மருத்துவ குறிப்புகளை வெளியிட தடையாக இருக்க மாட்டேன் என உண்மையாக சம்மதிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம் :_____ இடம் _____தேதி _____
/கட்டைவிரல் ரேகை

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் : _____

_____

ஆய்வாளரின் கையொப்பம் :_____இடம் _____தேதி _____

ஆய்வாளரின் பெயர் : _____

ஆய்வகம் : _____

CASE REPORT FORM

"COMPARISON OF Y – MODIFICATION OF TRANSCONJUNCTIVAL APPROACH VERSUS SUBTARSAL – LATERAL EYEBROW APPROACH IN THE MANAGEMENT OF ZMC FRACTURES"

GROUP : _____

Patient's Name : _____

Age/ Sex : _____

Patient's Identification No : _____

Contact Address : _____

_____

Contact No : _____

Institution : TamilNadu Govt. Dental College & Hospital,

Chennai - 600 003.

Centre : Dept. of Oral & Maxillofacial Surgery, TamilNadu Govt. Dental College and Hospital,
Chennai - 600 003.

Patient'sIdentification / O PNo : _____ Date: _____

DETAILS OF SURGERY

Procedure followed : ORIF.

Duration of Surgery : _____

Any other information _____

Details of Drug therapy : _____

Name of the Investigator : _____

Signature of Investigator : _____

CASE SHEET PROFORMA

PATIENT : **OP. NO : 010790**

AGE / SEX :

CHIEF COMPLIANTS :

MODE OF INJURY :

PAST MEDICAL/
SURGICAL HISTORY :

GROUP : Group A or Group B

CLINICAL EXAMINATION

EXTRAORAL : Subconjunctival haemorrhage

Circumorbital echymosis

Facial asymmetry

Step deformity and tenderness

Mouth opening

INTRAORAL : Occlusion

INVESTIGATIONS

Routine blood investigations.

Radiographs : PNS view, Submentovertex view

CT scan – axial, coronal, sagittal with 3D reconstruction.

DIAGNOSIS :

SURGERY DONE :.

INTRAOPERATIVE/
POSTOPERATIVE COMPLICATIONS :